The Engineer

LONDON, FRIDAY, DECEMBER 11, 1942.

PUBLIC NOTICES

ALFORD URBAN DISTRICT COUNCIL

WATER PUMPING MACHINERY

The Above Council is Prepared to receive TENDERS for SUPPLY, DELIVERY, and ERECTION at the Alford Pumping Station of a 12,000 Gallons per ... HORIZONTAL CENTRIFUGAL PUMP ... ELECTRIC MOTOR, together with all the ... ELECTRICAL EQUIPMENT, SUCTION and DELIVERY PIPING, VALVES, &c. ... lift about 230ft.

... and specification may be obtained from ... Council's Consulting Engineers, Messrs. ... Radford and Son, Albion Chambers, King ... Nottingham, on deposit of One Guinea ..., which will be returned on receipt of a ... Tender.

... lowest or any Tender will not necessarily ... accepted.

... Tenders, endorsed "Water Pumping ...," to be delivered at my office, as ..., not later than Wednesday, the 30th day ... December, 1942.

... successful contractor will be required to ... into an approved form of contract and bond ... due execution of the works.

H. SHIPTON,
Clerk to the Council.

... South Market Place,
Alford, Lincs.
5th December, 1942. 9094

SITUATIONS OPEN

... OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

... the benefit of applicants, the Proprietors ... prepared to insert brief notices that vacancies ... list, upon receipt of notifications from the ... ...ations. These notices (limited to one line) ... be free of charge, and co-operation is ... for.

IMPORTANT

... Advertisers in Situations Open Column ... should make themselves acquainted with ... terms of

STATUTORY RULES & ORDERS
1941 No. 2069
... RESTRICTION ON ENGAGEMENT ORDER

WANTED, COMPETENT MAN, to Take Charge of Labour or Employment Office of Engineering Factory employing approximately 750 ... in South-West England area. Applicants ... be fully conversant with Restriction of ... Order, Essential Works Order, and ... had extensive experience in all labour ... pertaining to engagement, discharge, and ... procedure. Applicants should state age, ... details of experience to date, salary required, ... whether free for engagement, together with ... of recent testimonials.—Address, 9030, ... Engineer Office. 9030 A

WANTED, MANAGER ENGINEER, Age ... 30/35, for Government Work. Yorks, West ... Factory 200 hands. Particulars and ... required.—Address, 9036, The Engineer ... 9036 A

WANTED, METALLURGIST, to Take Charge ... of Metallurgical Research of Large ... in London district manufacturing ... and other Scientific Instruments. State ... qualifications, experience, and salary required.—... 9098, The Engineer Office. 9098 A

A VACANCY OCCURS for MAN with Executive ... ability to Take Charge of Fitting and ... Lines in large Aircraft Factory. Must ... had experience in similar capacity. Please ... stating age, experience, and salary re... —Address, 9064, The Engineer Office. 9084 A

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... (Mechanical) REQUIRED for Per... manent post on work of first national ... Requirements: Excellent general ... technical education, apprenticeship, and ... experience covering large-scale pro... Age not over 42. Salary £1000 p.a., ... rapid advancement to suitable man.—... which are confidential, must ... full details of qualifications, positions ... and salaries received, Box 286, Strand ... London, W.C.2. 9085 A

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE

ARRANGED FOR CARD INDEXING
(TABLE OF CONTENTS, PAGE 480)

Deep Tunnel Air Raid Shelters No. III (P. 472)
THE ENGINEER, 11 - 12 - 42

Repair and Salvage of Aero-Engines (P. 475)
THE ENGINEER, 11 - 12 - 42

The British Merchant Shipbuilding Programme in North America, 1940-42—No. II (P. 482)
(R. C. THOMPSON & H. HUNTER) THE ENGINEER, 11 - 12 - 42

Railcar Oil Engines in the Argentine No. IV (P. 483)
(C. R. PARKER) THE ENGINEER, 11 - 12 - 42

Some Old Tools in Hereford Museum (P. 477)
(F. C. MORGAN) THE ENGINEER, 11 - 12 - 42

Fast Fighters (P. 480)
THE ENGINEER, 11 - 12 - 42

Civil Engineers and the Building Industry (P. 486)
THE ENGINEER, 11 - 12 - 42

BABCOCK VALVE VALUE

INDEX TO ADVERTISEMENTS, PAGE 55

SITUATIONS OPEN

GENERAL FOREMAN REQUIRED for Lathes, Drills, Welding and Metal Working Shops. Energetic and progressive man. Essential works.—Address, 9092, The Engineer Office. 9092 A

MANAGER, Air Conditioning, Heating, and Ventilating Dept., essential firm, South London. Must be fully experienced.—Address, giving full details of past experience, age, and salary required, 9076, The Engineer Office. 9076 A

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REQUIRED, EXECUTIVE for Machine Shop, Tool Room, Press Shop, &c., for large works. Please reply, stating age, experience, and salary required.—Address, 9082, The Engineer Office. 9082 A

REQUIRED, PRODUCTION and PLANNING ENGINEER, with administrative ability, for large factory. Must have had considerable experience. Please reply, stating age, experience, and salary required.—Address, 9083, The Engineer Office. 9083 A

SHIPBUILDER REQUIRED for Nationally important work. Highest technical qualifications and good executive experience in charge of Shipyard Production absolutely essential. Age 30-42. Salary £1000 per annum, rising in four years to £1800 per annum. Permanent appointment with considerable scope.—Write full particulars, including age, education, qualifications, and experience, in chronological detail, with salaries earned, to Box E.295, Strand House, London, W.C.2. 9093 A

SUPERVISOR REQUIRED by Large Motor Vehicle Manufacturing Organisation, to Control Training Scheme for Engineering Pupils and Apprentices. Approved applicant will require to possess a sound educational and engineering background and also good organising ability; he must also thoroughly understand youth psychology and be capable of inculcating discipline by virtue of self-capacity for leadership.—Address, 9088, The Engineer Office. 9088 A

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A close association with Aircraft and a sound Electrical knowledge are necessary in order that future aircraft requirements may be foreseen, and sufficient drive is expected to bring to a successful conclusion agreed development work within a reasonable period.

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Applications, with full particulars of education and subsequent experience, should be sent to Box E.414, Scripps's Advertising Agency, South Molton Street, London, W.1. 9051 A

THE Post You are Seeking May Not be Advertised in this Column, but do not lose the Opportunity of Bringing your Requirements before all those who would be interested and could employ you. An Advertisement in the "Situations Wanted" Column would be seen by all Leading Engineering Concerns for the cost of Four Lines, 6s.; 1s. 6d. for each Additional Line. There is no better way of covering so large a field for such a small charge.

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For continuation of Small Advertisements see page 2.

SITUATIONS WANTED, Page 2
AUCTIONEERS & VALUERS, Page 56
FOR SALE, Page 56
MACHINERY, &c., WANTED, Page 2
FOR HIRE, Page 2
MISCELLANEOUS, Page 2
PATENTS, Page 56
SUB-CONTRACTING, Page 2
EDUCATIONAL, Page 2

For Advertisement Rates see First Column Overleaf

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The Engineer

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Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher; all other letters are to be addressed to the Editor of THE ENGINEER.

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SITUATIONS WANTED

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9077 K

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For continuation of Small Advertis ments see page 56.

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all geared, hardened and ground throughout, ball and roller bearings, swivelling head, 30"x8" Table
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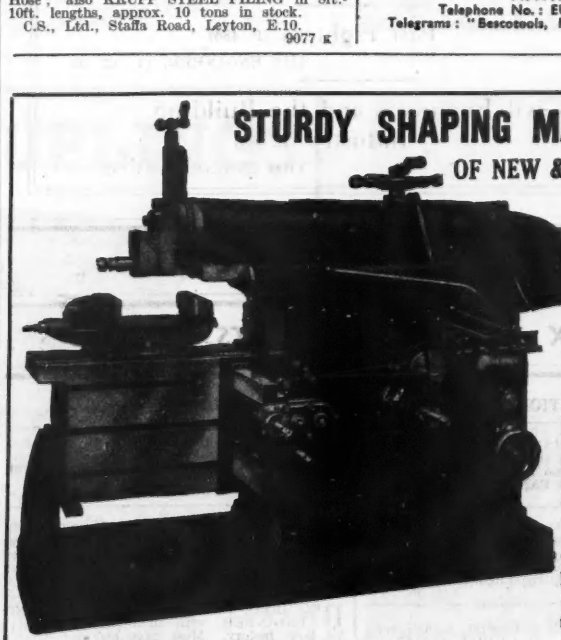

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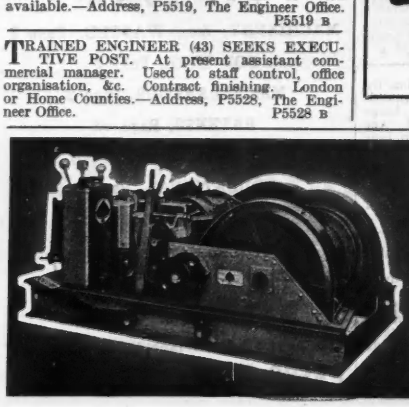

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A Seven-Day Journal

Industrial Management

IN a recent letter to the editor of *The Times*, Professor C. E. Inglis, of the Engineering Laboratory, Cambridge, points out that amidst much nebulous planning for the education of engineers and industrialists, in order to meet present and future developments, the proposal to establish a residential staff college for the teaching of and study of industrial administration stands forth with such stimulating and independent clarity that immediate action can, and should, be taken. Although some preliminary instruction in the subject may with advantage be given while a young man is still *in statu pupillari*, the intensive study of industrial and engineering administration should, Professor Inglis says, be deferred to a post-graduate stage. By this time, he points out, the student will have acquired some practical experience and a background against which problems of management can be reviewed in their proper perspective. Young men, he goes on to say, who in the course of their practical training have shown the necessary aptitude, and in consequence been earmarked by their employers for managerial appointments, could, at the age of twenty-seven or thereabouts, be seconded to the staff college for a period of, say, six months' intensive training. Living together, they would have an opportunity of exchanging ideas and getting to know those who, in years to come, will be their opposite numbers in other firms throughout the country. The desirability of establishing a similar college for the Civil Service has also been raised, but Professor Inglis points out that the primary duty of the Civil Service under normal conditions is to implement rather than initiate, and for this purpose caution and a judicial mentality are the characteristics that should predominate. On the other hand, leadership in industry demands forward thinking, initiative, and the courage to take quick decisions, these being the leading qualities which ensure success. Accordingly, in the training of engineers and industrialists for positions of high managerial responsibility, it is of vital importance that the standards and type of instruction should be laid down by those best qualified to do so, and that is by industry, aided by the leading engineering and industrial institutions. Civil servants, Professor Inglis concludes, could with advantage be admitted in limited numbers to the industrial staff college; but, to suit the requirements of this minority, the activities of the college must not be diverted from their clearly defined and all-important purpose.

Electric Welding in British Shipyards

A FURTHER step has been taken by the Admiralty to support the extension of electric welding in British shipyards, by arranging, in conjunction with the Glasgow Corporation, courses of three weeks' duration on shipyard welding methods and practice, at Stow College School of Engineering in Glasgow. The classes will be under the general control of Mr. William Heigh, of Babcock and Wilcox, Ltd. The course will include demonstration welding lectures and practical welding, using both D.C. and A.C. equipment, including an A.C., 600-ampere, multi-operator plant on war-time specification, B.S. 1071—1942. Cinematograph films of the latest American welded shipbuilding methods, also training films for welders will be shown. Among the lecturers who have consented to take part in these courses are Mr. W. G. John, Superintendent of Welding Development (Naval Construction), the Admiralty; Mr. R. B. Shepheard, Superintendent of Welding Development (Merchant Shipping), the Admiralty; Mr. F. R. Mansell, Superintendent of Welding Development (Naval Electrical), the Admiralty; Mr. A. Ramsay Moon, Advisory Service on Welding, the Ministry of Supply; Dr. E. G. West, Wrought Light Alloys Development Association; Mr. William Heigh, of Babcock and Wilcox, Ltd.; Mr. F. C. Cocks, of Lloyd's Register of Shipping; and Mr. J. Turnbull, of the British Corporation. At the end of each course a closing discussion is held, which is attended by Mr. John and Mr. Shepheard, representing the Admiralty, and representatives of Lloyd's Register and the British Corporation. The first course, we learn, was attended by senior members of the managements, drawing-offices, and shipyards from all British shipbuilding centres, and considerable interest is being shown by all the shipbuilding firms.

New Admiralty Appointments

ON Friday, December 4th, two new appointments were announced by the Board of Admiralty. Commander C. F. Goodeve, D.Sc., F.R.S., R.N.V.R., has been appointed to the post of Assistant Controller (Research and Development) in the Admiralty, and Sir Stanley V. Goodall, the Director of Naval Construction, to the additional post of Assistant Controller for Warship Production. Sir Stanley Goodall will, it is stated, remain the principal adviser to the Board of Admiralty on the design of warships and other vessels for the Royal Navy. Commander Goodeve, it is further announced, will be responsible for the co-ordination of research and development in the department of the Controller of the Navy, and for ensuring that scientific opinion is adequately represented in those departments, and that due weight is given to it. In his capacity as Assistant Controller for Warship Production Sir Stanley Goodall will be responsible, under the Controller of the Navy, for the production of warships and their completion with all appropriate supplies, and for the necessary co-ordination in order to achieve the fastest possible results with the greatest economy of effort.

The Hoover Medal

IT is announced by the American Society of Mechanical Engineers that Mr. Gerard Swope, the president of the General Electric Company, New York, has been selected as the sixth recipient of the Hoover Medal. The Medal will be presented to Mr. Swope during the Winter Convention of the American Institute of Electrical Engineers during the week beginning January 25th, 1943. It will be recalled that the bestowal of the Hoover Medal is administered by the Hoover Medal Board of Award, which consists of representatives of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. It was founded on April 8th, 1930, during the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers, with the purpose of honouring engineers whose pre-eminent services have advanced the wellbeing of mankind and whose talents have been devoted to the development of a richer and more enduring civilisation. The Hoover Medal, in short, is awarded in recognition and appreciation of those principles and ideals of civic obligation and of public service exemplified by the life and work of Herbert Hoover, to whom the first award was made. Other recipients of the Medal have been Ambrose Swasey, John Frank Stevens, Gano Dunn, and D. Robert Yarnall. Gerard Swope, to whom the sixth award is to be made, was born in St. Louis in 1872. He graduated from the Massachusetts Institute of Technology in 1895, and began work in the Chicago shops of the Western Electric Company. By 1913 he had risen to the office of director and vice-president, in charge of all commercial work and operations abroad. After serving on the Army General Staff in the 1914–18 war, he joined the General Electric Company in 1919, becoming the president of the International General Electric Company. In 1922 he became president of the General Electric Company, and in 1927 the chairman of the board of the International General Electric Company. In January, 1940, he resigned the office of president of the G.E.C., but continued to serve as a director of the company and as chairman of the International Company. During the last two and a half years he has served as Chairman of the New York City Housing Authority, and assistant to Mr. Morgenthau, the Secretary of the Treasury. In September, 1942, he was elected president of the General Electric Company a second time.

The Late Mr. Albert Kahn

THE death, in Detroit, on Tuesday, December 8th, of Mr. Albert Kahn, the well-known industrial architect and engineer, of America, will be widely mourned by those of our readers who are interested in factory design. He was the designer of America's principal automobile plants, and he designed and built factories for the Packard, Ford, Chrysler, and General Motors concerns. After the Pearl Harbour disaster he was one of the first men to be called in for consultation with regard to the construction of America's new armament works. Among those works may be counted the factory of the Wright Aeronautical Corporation at Cincinnati, the bomber works of Ford at Willow Run, and the Chrysler aircraft engine factory at Chicago. In his forty years of work in America he and his brothers, together with their organisation, had constructed something like 150 different plants with a value of something over £400,000,000. In 1928 he went to Russia to assist in the first Five-Year Plan, and in two years he had trained about 4000 Soviet engineers and had supervised the design and erection of some 520 different factories. In his own firm more than 500 assistants were employed on the design of factories, and their building on a mass production basis. Albert Kahn was of German birth and was seventy-three years of age. He was trained as an architect and gained a scholarship which enabled him to travel in Europe. He returned to Detroit and set up his own business, in which he was joined by his brothers. The spread of industry brought new problems of factory and housing construction, which he successfully solved, and his firm became one of the leading authorities on reinforced concrete construction. In later years he specialised in factory construction, but he retained his personal interest in house construction.

Welfare in Industry

AT the recent annual general meeting of the Industrial Welfare Society, which took place in London, a telegram was read from His Majesty the King, expressing his pleasure on hearing of the progress made during the year, and his best wishes to the members for the continued success of their all-important work. The chair was taken by Sir Charles Craven, who emphasised in his speech the vital contribution which welfare work was making to the war output. He stated that over 500 more firms during 1942 had found how greatly welfare work had added to their all-round efficiency. Next year, said Sir Charles, the Society would have to render a greater service to industry than it had ever done before. There was no doubt that the part-time employment of women in industry would raise very great problems in connection with dependent children and general domestic difficulties. In the heavy engineering industries there were firms which a year ago would not have contemplated the employment of women in their factories. They had now tried it and were invariably enthusiastic about the results. Employers were realising the very great responsibility which was falling on them to-day of taking more interest in their workpeople. The Industrial Welfare Society, Sir Charles pointed out, could render considerable help in preparing for post-war conditions in that most important direction, the human side. In the future it would be necessary for employers to show good industrial statesmanship, but good will would be required on both sides by the employers and those they employed. The past year had seen increasing co-operation between the Government Departments and the Society, and a wide range of industrial welfare work had been successfully carried out.

Deep Tunnel Air Raid Shelters

No. III—(*Continued from page 458, December 4th*)

SPECIAL SHIELD

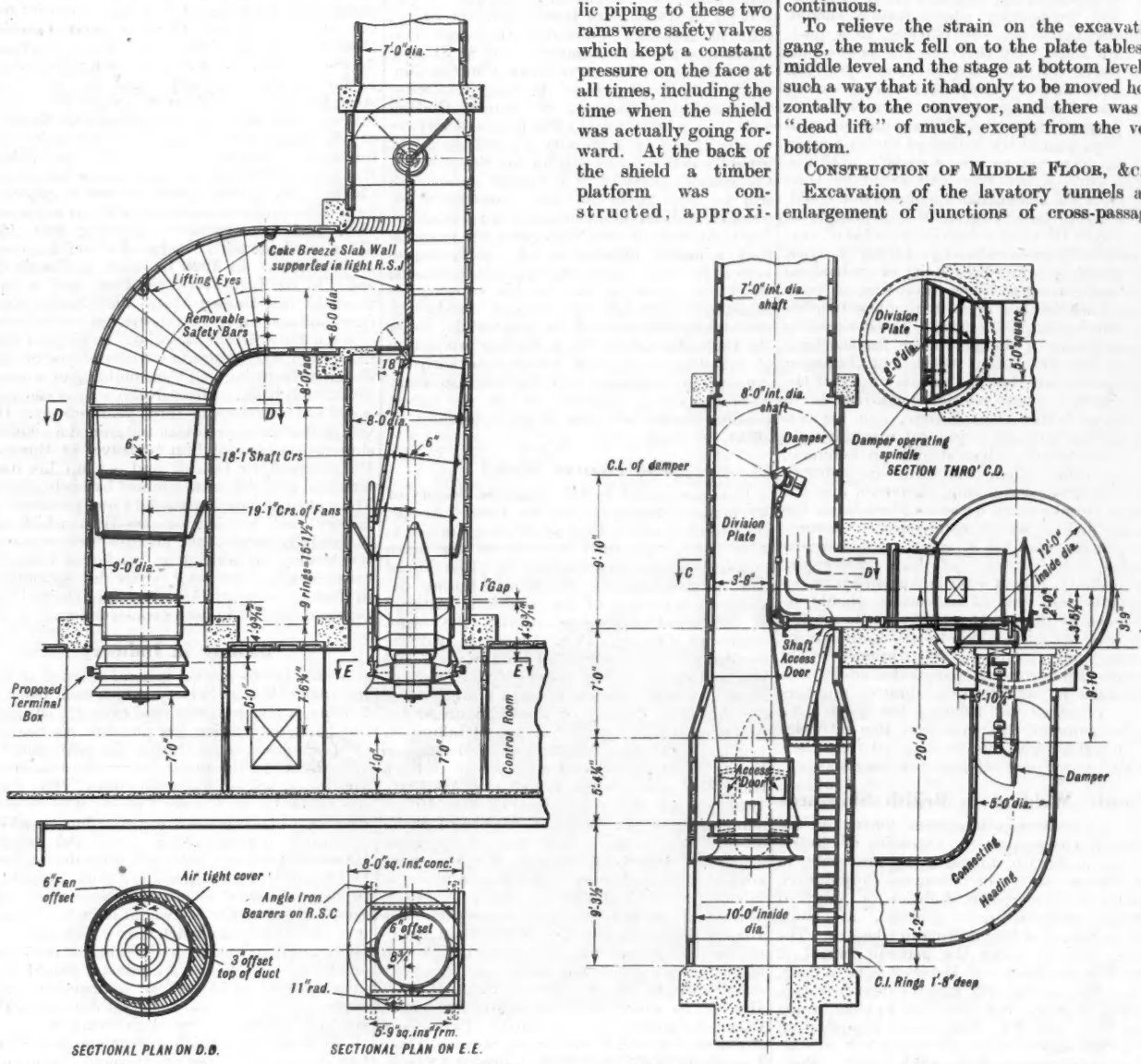
IT may be of interest to describe this shield in more detail, for the consulting engineers are of the opinion from experience gained that it is a big advance on previous shields. One of its advantages is that continuous excavation is maintained at the face, whilst the erection of rings and grouting is completed at the same time without mutual interference. The shield was constructed from four rings of 16ft. 6in. diameter cast iron lining, packed out to 16ft. 8in. diameter, and then studded to a 1in. mild steel shield skin. The flanges of two of the rings were cut away to enable hydraulic jacks (second-hand) to be bolted flat against their cast iron skin. Annular rings, made by welding together two 1in. thick mild steel plates, were bolted between the second and third rings of cast iron, and at the face of the back ring to strengthen the whole structure and the conical space between the leading edge of the steel skin and the leading ring of cast iron was filled with reinforced concrete to form a cutting edge. The shield was stiffened vertically by two 12in. by 6in. rolled steel joists and horizontally by a 15in. by 6in. rolled steel joist, which was laid on its flat at approximately axis level. At axis level two 1in. plate tables, one on each side of the centre line of the shield, were constructed, and they were moved forward to "hold" the face by two hydraulic rams which were placed underneath. On the hydraulic piping to these two rams were safety valves which kept a constant pressure on the face at all times, including the time when the shield was actually going forward. At the back of the shield a timber platform was constructed, approximately 35ft. long, which was pulled by the shield as it travelled forward. This travelling platform was able to slide on temporary steel brackets bolted to the permanent concrete lining and an endless belt conveyor was constructed from the bottom box of the shield rising up to the top of the platform and proceeding back to approximately 45ft. from the face. This enabled the excavations from the shield to be loaded approximately 45ft. from the face, leaving the whole of this room free for the handling of the precast concrete tunnel lining. To erect this lining an electrical winch was installed on the moving platform, and at the rear end of the top half of the shield a semi-circular rib was bolted to the platform and 2½in. diameter rollers, approximately 3ft. 4in. long, were coupled to the outside of this ring, and the first annular plate of the shield. This enabled the permanent lining to be drawn up from the invert and rolled round over the top of these rollers into its correct position, and thus kept the centre of the shield free from obstruction. Three railway tracks were laid in the invert to the tunnel (as low as possible), one track being used for tunnel lining and cement only, and the other two tracks so used that the feeding from the conveyor of the excavated material was continuous.

To relieve the strain on the excavating gang, the muck fell on to the plate tables at middle level and the stage at bottom level in such a way that it had only to be moved horizontally to the conveyor, and there was no "dead lift" of muck, except from the very bottom.

CONSTRUCTION OF MIDDLE FLOOR, &C.

Excavation of the lavatory tunnels and enlargement of junctions of cross-passages and shelter tunnels was undertaken as soon as the excavation of the main shelters had been completed.

The middle floor at horizontal diameter level was proceeded with as soon as the cessation of tunnelling work permitted. More working shafts would have been of great assistance during this work, and during the whole of the equipment work, as the two sunk were in constant use and tended to be bottle-necks. On the average, there was one lift every 40 sec. The middle floor is carried



FIGS. 9 AND 10—ARRANGEMENT OF VENTILATING FANS

by 6in. by 6in. by ½in. tees, 16ft. 6in. long, placed across the tunnel at 6ft. centres and supported on angle brackets fixed to the tunnel lining, and also on 4in. by 2in. steel channel columns placed at approximately mid-span. Precast reinforced concrete slabs, 6ft. in length and 6in. deep, but coffered for the sake of economy of material, are laid between and rest on the tees. Erection was very rapid. The bottom floor consists of precast reinforced concrete slabs. The tunnels were cleaned out as the construction of the floors proceeded. The joints in the lining were pointed and also caulked where necessary, and the whole lining was then sprayed with Limbux to give a clean and light appearance.

Immediately the working shafts could be spared the hoisting gear inside them was removed, and the erection of the spiral staircases put in hand. They are of steel with precast reinforced concrete treads, and their

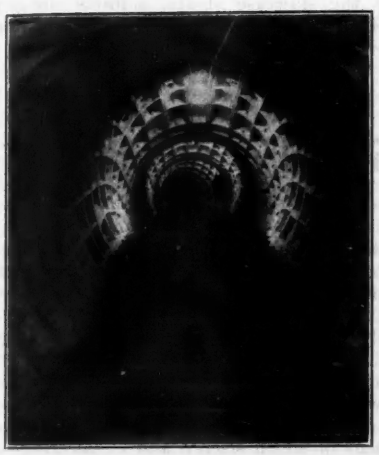


FIG. 11—ACCESS STAIRWAY

manufacture was a somewhat difficult operation, as they are of a double spiral nature, in order that the occupants of each floor can proceed to their shelter by separate staircase, thus providing rapid access. They were manufactured by Joseph Westwood and Co., Ltd.

The staircases are brought up to a few feet above ground level to prevent flooding of the tunnels from burst water mains. They are protected from bombing by means of heavily reinforced concrete pill-boxes roofed over with heavy steel troughing, 9in. deep, and a slab of reinforced concrete, 5ft. deep—Fig. 4 (*ante*).

The central staircase giving access from the tube railway stations was driven by tunnelling and was lined with reinforced concrete lining of 9ft. 9in. diameter—Fig. 11. Folding Bostwick gates and smoke doors are provided to isolate these staircases if necessary.

LINING OF TUNNELS

The shelter tunnels for one-third of their length are lined with cast iron and for two-thirds with reinforced concrete. As the shelters were begun in wintertime, it was appreciated that there might be delays in fabricating the reinforced concrete rings, and the work was therefore begun with cast iron rings. The cast iron rings were of standard type, and the reinforced concrete rings were a development of rings 12ft. 3in. in diameter adopted in a pre-war extension of the London Passenger Transport system. The latter were manufactured by three different firms, all of which used vibratory methods to consolidate the concrete. The firms were the Empire Stone Company, Ltd., Kinnear, Moodie and Co., and Stent Precast Concrete, Ltd. The specification called for a strength of concrete in compression of 4000 lb. to the square inch in seven days and 6000 lb. at twenty-eight days. The exact mix was left to the contractors so as to tie their hands as little as possible, provided that the strength and a very dense product was obtained. The coarse aggregate was not to exceed ⅜in. No great difficulty was experienced in obtaining the strengths required, but considerable variations prevailed. In an endeavour to obtain a more scientific concrete, by greater knowledge of the water content in the sand and aggregate, Kinnear, Moodie and Co. installed a weighing plant, whereby the moisture content of each batch of sand and aggregate was obtained, and the water that had to be added adjusted accordingly. The resulting water ratio averaged 0·42, and the seven-day strengths varied from 4200 to 6800 lb. per square in. and the twenty-eight-day from 6500 to 8500 lb. per square in. The concrete averaged about 150 lb. per cubic foot. As mentioned above, all three firms used vibratory methods to compact the concrete. Both Kinnear, Moodie and Co. and Stent Precast Concrete, Ltd., used vibration tables to which the moulds were bolted. The vibration tables were controlled by solenoids, giving 3000 vertical vibrations per minute with an amplitude of $^{1}/_{64}$in. The frequency was controlled by the cycles of the electricity supply and the vibration was therefore constant and not affected by any drop in voltage. The Empire Stone Company used three types of vibration: firstly, pneumatic vibrators in sets of two clamped to the mould; secondly, a high-frequency vibrating table, giving 3000 vibrations a minute; and, thirdly, a shaking table operated mechanically. The test cubes gave a weight of about 152 lb. per cubic foot.

Each ring consists of eight segments and a key, which are bolted together in the same way as the more usual cast iron. The manufacture of the segments required a high degree of accuracy, particularly in the radial joints, and therefore called for careful construction of the moulds. To begin with, the moulds were made of timber. They were of very strong construction, bolted together, and comprised an arched base with fixed cross-joint ends and loose sides, the whole bolted to the vibration table. During the checking of these moulds day by day it was frequently found that the whole of the base had warped, and become slightly off the square or slightly twisted. Some of the cross joints were also found to move away from their correct position. These faults resulted from shrinkage and warping of the timber due to the concrete, vibration, and weather. An all-steel mould was then tried. It was made up with a steel channel base and plated arch, together with fixed steel ends and loose steel sides, the whole of the core-boxes being loose for "striking" purposes. The main faults with the steel moulds are very similar to those of the wooden moulds, in that they were found on many occasions to be slightly twisted, usually as a result of faulty slinging when handling. The steel mould gave a much better finish to the segment than that made from the wooden mould. Eventually a precast concrete mould was used for the base, and proved very successful. The sides and the ends were made of timber and were a grooved fit into the concrete base.

No difficulty was experienced in erecting the reinforced concrete lining. The weight

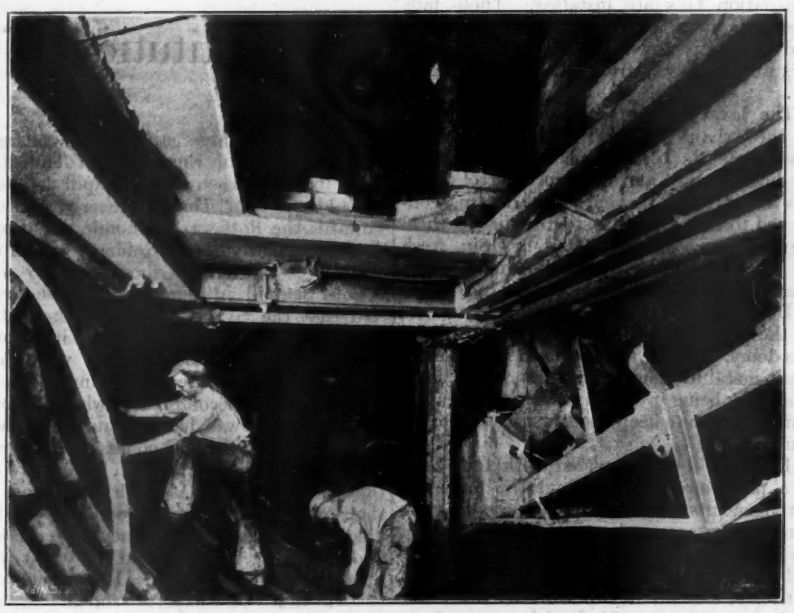


FIG. 12—VIEW OF SPECIAL SHIELD

of each segment was much the same as that of the cast iron segments. A certain amount of damage was done by rough handling, but not sufficient to affect the strength. Trouble did, however, occur where, through faulty erection, the rings were out of shape and line pressure took place on the inner edge of the radial joints. The concrete gave way under this pressure and a certain number of segments had to be renewed. The radial joints of the reinforced concrete lining were made in the first instance with bitumen and hessian sheet packings, ⅛in. thick. These were, however, found to flow under the pressure, and creosoted wood packings were adopted. The radial joints of the cast iron lining were machined. All the circumferential joints were made with tarred hemp rope. Hemp grummets were used under the washers of all the bolts.

VENTILATION

Very careful thought was given to the ventilation of the shelters. It was realised that the main difficulty would arise in hot weather when the natural temperature, together with heat from the lighting and

from the bodies of the occupants, might well cause unbearable conditions, both from heat and humidity. Three ventilation firms submitted quotations, and ultimately orders were placed with Aerex, Ltd., and with James Howden and Co., Ltd.

The method of ventilation is the same at all eight shelters. The fresh air enters through the entrances in the pill-boxes, passes down the spiral staircases, and thence into the body of the shelter and lavatory tunnels. The vitiated air is extracted by means of a sheet metal duct in the roof of the tunnel and also by means of the space under the bottom floor, which forms a bottom duct. The top duct is provided with "hit-and-miss" regulators, spaced 36ft. apart, close to the cross-passages and 24ft. apart towards the centre and ends. The bottom duct is fed by means of exhauster risers which draw off the air from the underside of the middle floor. Both these ducts are joined together opposite the lavatory tunnels. They are then connected to the space under the lavatory floor, and then by 4ft. 6in. by 3ft. 6in. tunnelled headings led either to the isolated bottom of the staircase shafts or to isolated portions of the access passages, where the ventilation fans are installed. These fans eject the air up a 7ft. shaft to ground level, and an exhaust tower, 30ft. high, then carries this air well away from the incoming fresh air.

The lavatories are separately connected to the exhaust system. In addition, each closet has its own connection to a duct. Medical aid post and wardens' control offices are also fitted with ventilation ducting connected to the exhaust system. The electrical control rooms are ventilated by 18in. fresh air delivery ducts from the entrance lift shaft.

During a gas attack, when the entrances to the pill-boxes would have to be closed by gas doors, fresh air is introduced by means of sheet metal ducting above the pill-box, filter chambers being provided in the more heavily built-up areas to keep back dust from bombed buildings.

Each shelter is provided with four fans, two per staircase shaft, and the necessary arrangements in the way of dampers and cross connections are made, so that each half of the shelter can readily be ventilated by one only of the two fans at only slightly reduced capacity, and in the worst event the whole shelter can be provided with as much as 40 per cent. of its peak rating, even with only one of the four fans still in operation. The maximum rating of the fans is 40,000 cubic feet per minute each at a pressure of 3in. to 3·25in. W.G.

The fans are electrically driven, and the supply of power is in duplicate. The motors, 28 B.H.P., are wound for D.C. at 630 volts, and are arranged for speed regulation by shunt field control incorporated in hand-operated Brookhirst drum type starters, located in the control room.

On account of the varying conditions of occupation of the shelters and changes of weather, a wide range of ventilation was considered desirable. It is secured under normal working conditions by the use of either one or two fans at each shaft, and, further, by the speed control available. On the basis of 8000 occupants per shelter and assuming 400 B.Th.U. of heat given off per person per hour, the calculated temperature rise, excluding heat losses through walls, would be 17 deg. Fah. It is not possible, meantime, to say what heat losses will occur through the walls in such tunnels, but possibly a reduction of 15 per cent., making a final temperature rise of 14 deg. Fah. In summer, assuming ambient night temperature of 60 deg. Fah., the shelter temperature might be 74 deg. Fah., which would be satisfactory.

The maximum capacity catered for gives a large margin, which was considered desirable in a new development of this type, 80,000 cubic feet of air per minute being available at each shaft with two fans running. As the same ductwork is in circuit with only one fan running the volume reduction for a single fan is not extreme, the capacity under such conditions being approximately 80 per cent., as compared with the two fans in operation. The speed control enables either rating to be reduced progressively as desired down to 70 per cent.

The fans provided by Aerex are of the single-stage, while those by Howden are of the two-stage type. The Aerex fans run at speeds of 485 to 685 r.p.m., and the Howden fans at speeds of 500 to 785 r.p.m.

The discharge of each fan terminates in one half of the circular discharge shaft, in which is installed a three-way damper—Figs. 9 and 10—so that either fan may be blanked off or both fans run together. The damper is controlled from the fan chamber by an operating shaft terminating in the worm gear at the position of the damper, a position indicator being provided at the lower level. The restrictions of deep tunnelling construction render the full streamlining of fan outlet and other ducts in some cases prohibitively expensive or lengthy, so that the fan outlet details are not fully streamlined. The fans were mounted either vertically or horizontally to accommodate themselves to the tunnelling conditions.

When the fans are providing 80,000 cubic feet of air per minute from each shaft—that is, a total of 160,000 cubic feet per minute—the supply per person is at a rate of 1200 cubic feet of air per hour, which is well above London County Council theatre standard. The number of changes per hour is fifteen. The fans are reversible, and the whole system can be changed over, fresh air being brought in by the top and bottom ducts, and the vitiated air discharged up the staircase shafts, suitable dampers being provided to deal with the lavatory ventilation.

Institution of Civil Engineers

THERE was a large gathering at the Institution of Civil Engineers on Thursday, December 3rd, when Lord Sempill delivered an address on "The Engineer's Attitude Towards the Post-war Economic Situation." Sir John Thornycroft, President, was in the chair.

Lord Sempill, in the course of his address, said that the civil engineer, accustomed to long-term planning, might well, in a brief pause from the pressure of war work, look ahead to the immense programme of reconstruction to be accomplished when the orgy of destruction was halted, and might well speculate on things to come. In the past engineers as a body had been inclined to say they were technicians with experience in their own line, but they were not knowledgeable in national or international economic and monetary matters, and they left such questions to the experts. It was not suggested that the experts should be dispossessed, but rather influenced towards the making of a much-needed change in the system. This was an age in which science and technology were predominant, but the historic British system of education did not render people adequately aware of this fact and its implication, and it was therefore not surprising that the machinery of government lacked effectiveness in technical things. The first signs of official appreciation of this truth had come a short time ago, when a Scientific and Advisory Committee to the War Cabinet was set up under the able chairmanship of Lord Hankey, assisted by Professor Hill, the Secretary of the Royal Society, and other well-known men of science. Following upon this excellent lead, the Government had later established a similar committee to deal with engineering affairs, using men of high ability, such as Sir Henry Tizard, Technical Adviser to the Secretary of State for Air and the Minister of Aircraft Production. These were signs that the thin end of the wedge of science and technology was coming more and more to press itself into daily life, and this was a most welcome intrusion.

Parliament, through holding the purse strings, controlled the country, and it might be assumed, therefore, that there was an adequate number of representatives in both Houses with a deep knowledge of economics and monetary affairs. Yet the machinery of economics lagged far behind the great advances made in science and technology. The wealth of the country was derived from different enterprises, the majority of which owed their existence to the skill of engineers. In a country such as Britain, in the development of which science and engineering had played such a large part, it was perhaps surprising to discover that there was only a mere handful of qualified engineers in both Houses of Parliament. Substantial improvements were called for in the economic system, not only of this country, but of the world, and it would be appropriate that the British people, who had contributed so much to world development, should lead in the founding of a new technique in economics and monetary policy. Power production methods had so increased the output per man that it was vital that the monetary system should be so rearranged that sufficient money tokens were made available to permit of the full use of man power, acting through machinery, and with a call on virtually unlimited raw materials. If there were insufficient money tokens, prices must fall, thereby bringing about a whole devastating train of events, including unemployment, demoralisation, loss of confidence, class unrest, and general stagnation, all of which led to serious social upheaval. Under a revised monetary system it would be one of the main functions of the Treasury to put into circulation, without creating a debt, just sufficient new money to balance the increase in goods and services that were brought about by the full utilisation of man power and materials. By so doing they would maintain the price index constant. It was of the first importance that the value of the pound sterling should not vary, and the technique for achieving this should be to regulate the amount of money in circulation to correspond with the amount of goods and services produced. Under the present system many capital works were stifled at birth, and so engineers and steel, cement, and brick manufacturers remained idle, as did those who would have been employed in the

work of construction. The Government paid men for remaining idle by taking away a portion of the spending power of those in employment, thus reducing their ability to consume.

There was no subject more controversial than economics and monetary reform, primarily because it was so little studied and understood by those not specifically engaged in its work. One of the reasons for this might be that there was no agreed simple vocabulary whereby these matters might be explained and understood by all. The phrases used were unnecessarily obscure. For example, "purchasing power parity" generally had the effect of paralysing the layman's mind. He felt himself in the presence of a great mystery, and that his best course was to make a clean breast of it and say straight away that he knew nothing about high finance. But if the expert had talked about the "equal buying power" of two national currencies, he would have felt himself quite capable of grasping the significance of the phrase. Even greater objection could be taken to the type of expression freely used in the financial columns of the newspapers, which conveyed a totally wrong impression of what really happened. "Money leaving the country" conveyed the impression that pounds were actually being shipped out of England to some other country, whereas what actually happened was that certain private individuals, seeing a rake-off in some other country or a better rate of interest, were selling massive quantities of their nation's currency, so depreciating its value, disturbing the economic balance, and adversely affecting the interest of the entire community.

If Britain could broadcast to the world an announcement of a new world economy that would give real power to the ideals adumbrated in the Atlantic Charter, it would lighten immeasurably the days of darkness for those people who strove for freedom under the heel of the aggressor, and it would at the same time inspire the British people to look forward to the post-war period with a keen anticipation that their services would be used continuously in the vast work of reconstruction. There must be a fundamental flaw in an economic system when it converted international trade, which should be mutually advantageous and therefore a bond of union, into a competitive struggle of the most ferocious character in which the victor endeavoured to get the vanquished into a state of unpayable debt. There must be a flaw in the system which produced the cruel picture of men in need of the necessities of life being denied the money with which to buy them because there was a superabundance of those necessaries, and therefore they were not required to produce any more. Rationally, these things were quite indefensible. The time for half measures in mitigation of the consequences of error was past. What was required was a courageous tackling of root causes if civilisation was to be saved from major catastrophe. An improvement in the economic system was called for which would ensure, nationally, a stable price level and the abolition of enforced idleness, and internationally, the conversion of international trade from financial war to an exchange of goods and of services to the mutual advantage of both parties.

The principal economic problems to be faced after the war might be briefly enumerated as follows:—First, under-consumption, and the unemployment which was inseparable from it; secondly, the trade cycle; thirdly, the international financial problem, with which was bound up the struggle for favourable balances of payment, involving tariffs, quotas, and so on, the buying and selling of foreign currencies over the exchange by speculators and others, and the threat to the exchange value of national currencies, leading to unpayable debts; fourthly, the unwillingness, consequent upon their industrialisation, of primary producing countries, and more particularly the Dominions and India, to receive imports of manufactured goods which previously they had imported freely; fifthly, nations with different internal economic systems must be enabled to live in the same world without these differences constituting a threat to the continued existence of one another's internal systems; lastly, the movement of peoples from over-populated to under-populated countries. The objection of the latter to receiving immigrants was due to the unemployment of their own people, and would disappear when that problem was solved.

To solve the unemployment problem internal reforms were necessary. These were in themselves simple, logical, and capable of being put into effect, without having to require the business community as a whole to alter their customary procedure. Changes must always involve the acceptance of certain sacrifices by some interests, but the sacrifices would be accepted when there was conviction of the need for change. The problem of unemployment was one purely of equating effective demand with supply, whereas hitherto all effort had been directed towards trying to equate supply with effective demand, by scrapping first-class capital equipment, by the limitation of output, and by the deliberate destruction of real wealth. When there was a surplus of goods of all sorts overhanging the market and causing a slump, what was needed was that effective demand should be increased without the supply of goods awaiting consumption in the market being similarly increased. Engineers were responsible for the fact that this problem had arisen in an acute form due to their work in devising methods of power production, but those responsible for working the economic and monetary system during these changing conditions had lagged behind. While aware of the great benefits that engineers had conferred on the world, they had not translated these benefits into improvements of the economic system. Every avenue had been searched to find a solution to unemployment except the economic avenue, which was the one which contained the machinery for the distribution of money, and therefore was obviously the one in which the remedy could be found. The financial system was made for man, and not man for the financial system. It was invented by man to facilitate the production and distribution of real wealth, and instead it was now standing between him and the enjoyment of that ever-growing volume of material wealth which science and technology had made possible. History had shown how disastrous were the consequences when institutions blindly refused to adapt themselves to changing conditions and attempted to stem the flood of irresistible forces. The British Empire, comprising as it did one-third of the population of the world, had a great responsibility in this matter. It alone was in the position to establish within its boundaries a new monetary technique both nationally and internationally.

In conclusion, the lecturer urged his audience to study a report by the London Chamber of Commerce on "General Principles of a Post-war Economy," published last May and obtainable from the Chamber, and "A Twentieth Century Economic System," fifth edition, October, 1942, issued by the Economic Reform Club.

Repair and Salvage of Aero-Engines

LAST week we were invited to inspect the South Wales factory of the Propeller and Engine Repair Auxiliary (P.E.R.A.), a branch of the British Overseas Airways Corporation. This undertaking has recently been constituted to administer the work of repairing and salvaging aircraft engines for the Ministry of Aircraft Production. The particular works we visited was, we found, busily engaged on the carrying out of overhauls of radial aircraft engines, including both British and American designs, along with the salving of burnt-out and crashed engines, and we were able to see for ourselves some of the important work which is being done to maintain our war effort by upkeeping the supply of aircraft engines.

When war broke out there were few companies with more practical experience of maintaining and repairing aero-engines than the two principal British air transport firms, Imperial Airways, and British Airways. We may recall that when war was declared they were combined in order to form the British Overseas Airways Corporation. The engine overhaul factory was at that time situated at the Croydon aerodrome, and it was in the charge of Mr. G. A. Hummerstone, the overhaul superintendent, under the control of Mr. J. A. Robson, the Corporation's service engineering director.

Arrangements were made to utilise this valuable experience for the overhaul of engines for the Royal Air Force, through the Ministry of Aircraft Production, and on June 20th, 1940, it was decided to move the factory to a more suitable site in South Wales. The complete transfer of the plant and the operatives was completed within the short space of six days. Although the factory accommodation available had to be somewhat modified and special engine test beds designed and built, the delivery of overhauled aircraft engines to the Ministry was begun in July, 1940, and on July 26th the first delivery of reconditioned engines from the new engine test bed was made.

During the last two and a half years considerable expansion has taken place, and the workshops have been enlarged and the number of engine test bays increased. The total strength of the engine repair force has meanwhile been expanded nearly sevenfold, while the average rate of engine output has increased elevenfold. In August of last year women were first trained for this work by attending a special Board of Trade Training Centre, at which experience was gained in the dismantling and assembly of aero-engines. At the present time about 38 per cent. of the total number of employees are women who are doing excellently, more particularly in checking and inspection, with evident enthusiasm.

In November last a beginning was made with the new work of breaking down and salvaging aero-engines which in making a forced landing or on account of fire had

SALVAGE OF DAMAGED AIRCRAFT ENGINES

suffered such damage as to be considered by the Air Ministry to be beyond economical repair. At the time of our visit we were informed that already some 2500 different kinds of spare parts have been salvaged. A recent computation showed that the total cost of running this department of the works for a year showed a financial saving of some £120,000, compared with the cost price of thirty-five main items, more or less in constant demand, which had been salved from the engines delivered.

FACTORY ARRANGEMENT AND LAY-OUT

The main work of the repair side of the factory is controlled from the planning and statistics office, in which a record is kept on cards and on wall diagrams of the complete overhauls of engines received, and the smaller rectifications and partial overhauls which often come in as a result of minor crashes. In this office the output of components is controlled and the rate of output of the various departments so adapted that a steady flow of engines from the first stripping-down to the final assembly and erection is maintained. In the planning office the activities of some thirty-six sections are co-ordinated; near to that department is the general stores, in which component parts are received and despatched.

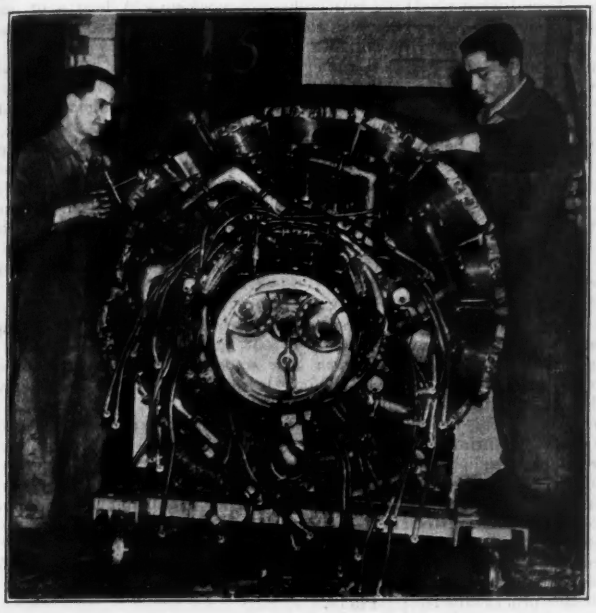
The first shop in the main works we visited was the dismantling and cleaning shop, in which the engines are taken to pieces and the parts degreased and cleaned ready for inspection. We show in one of our engravings a view taken in this department, illustrating the stripping-down of a "Hercules" engine. Women workers are freely employed in this section of the factory. The cleaned parts, we noted, are carefully examined and checked for wear and faults, and full use is made of micrometer gauges and special jigs designed and built by the service section of the Corporation. Among these we saw useful stands for the holding of engines during the dismantling process, and easily movable racks, covered with felt, for the stacking of component parts, which have to pass through different shops. Magnetic testing for cracks is used with both heavy and light amperage currents and with, of course, appropriate demagnetising coils. Among these plants we noted those of the Equipment and Engineering Company, Ltd. One shop is devoted to the overhaul of crank cases, cylinders, pistons, and valves. We illustrate herewith the testing of a "Pegasus" crank case for alignment. The cylinder bores are finished on Kitchen and Wade honing machines, while valve faces are trued up on special grinding machines made by Black and Decker, Ltd., and "Sidux" grinders by Albertson and Co., Inc., of America. In a small salvage department repairs are made to any of the engines going through the overhauling process.

In the magneto and carburetter section these parts are assembled and tested. A special test rig has been designed in order to allow necessary adjustments to be made to the cork floats, the jets, and the booster mixture control, and in other sections of the shops the fuel and lubricating pumps are tested. The component parts are then reassembled and the engines move forward to the assembly bay, where they are finally inspected and prepared for test. In all stages the work is carefully checked by officials of the A.I.D., who work in close collaboration with the firm's own inspectorate.

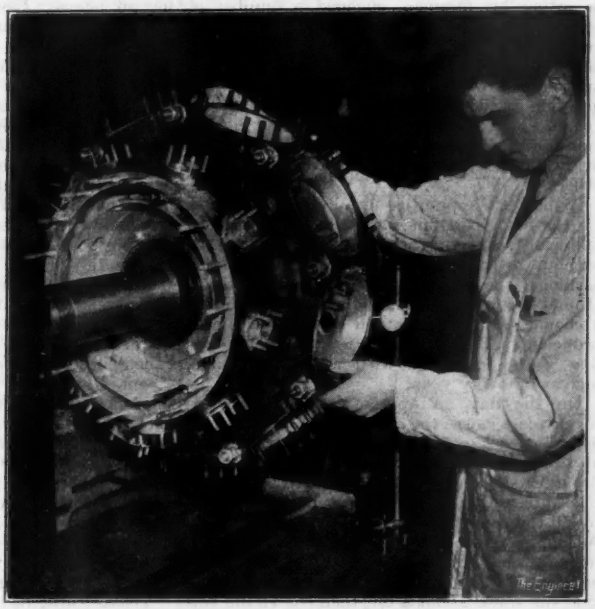
The engine test bays are built on a special site and are well equipped for the carrying out of the routine official trials. After testing, engines are checked over and final adjustments are made before despatch. Going through the works we noted engines of the Bristol "Perseus," "Pegasus," and "Hercules" classes and also Wright "Cyclone" engines. In all, twenty-two types of engines, including two Germans, have been dealt with.

AERO-ENGINE SALVAGE

One of the most interesting departments in the factory is that devoted to the salvage of crashed or burnt engines, which, after expert examination, are cut up with the oxy-acetylene torch and the parts dismantled in order to recover for Service use the maximum number of available components. These range from a few nuts and small parts to crank cases, pistons, cylinder liners, and crankshafts. After the recovery of these parts the remaining damaged parts are sorted into heaps of iron, steel, non-ferrous, and light alloys for re-melting. The salvaged parts are first cleaned and then polished and are afterwards closely examined for flaws and the softening and warping which usually accompanies an engine fire. For testing, the hardness of individual components is tried in a Vickers diamond pyramid machine. Every part which successfully passes the rigorous tests imposed is marked with a special number to indicate that it is a salvaged part. By this means the history of individual parts can be traced, and records go to show that the majority of the parts recovered from these damaged engines are as good as new, and represent a great saving in material and man-hours. From what has been said it will be clear that work of a most important national character is being carried out by this special branch of the British Overseas Airways Corporation.



STRIPPING DOWN "HERCULES" AERO ENGINE



TESTING CRANKCASE ALIGNMENT OF "PEGASUS" ENGINE

Some Old Tools in Hereford Museum*

By F. C. MORGAN, F.S.A.

SINCE my appointment, in 1925, as Curator of Hereford Museum, it has been my endeavour not only to collect obsolete tools of all kinds, but also to find old craftsmen and learn from them how these tools were used. A good workman usually can be induced to talk about his trade, and if a shorthand typist can record this talk, many almost forgotten details too small to be recorded in books are brought to light. For example, the tanner's craft, once of great local importance, has been recorded from one since passed away; minute accounts full of details concerning the making of cart wheels and of wheelbarrows have been given me by a clever craftsman still active and keen upon his work; various other operations, such as the making of candles in farmhouses, the making of cheeses from ewe milk, &c., have been fully described.

The two crafts to which my talk will be confined are the cooper's and that of the making of wooden pumps. In the Museum there are almost complete sets of old tools for each of these crafts.

THE CRAFT OF THE COOPER

A set of tools used by John Brookes, of

* The Newcomen Society, Birmingham, December 9th, 1942.—Abridged.

Putley, whose apprenticeship indentures, dated February 27th, 1835, are with them, was given by one of his descendants in 1938. Most of the set would have been made by John Brookes during his apprenticeship and therefore can be dated fairly accurately. Early this year many others were given by Mr. J. Blainey, grandson of their original user, Peter Blainey, of Boughrood, Radnorshire. During the past few months a retired cooper, for thirty years with Messrs. Bulmer and Co., of Hereford, has called at the Museum to tell me his reminiscences, and from him nearly all the following facts are derived, though they have been supplemented by Mr. A. P. Quarrell, of Marden, who has also practically demonstrated the use of various tools.

Apprenticeship.—The custom of apprenticeship was similar to that in other crafts. A lad was bound by indentures for seven years, but no indentures were necessary for a son apprenticed to his father. The owner of a cooperage, or rather his foreman, engaged a number of coopers, according to the size of his business, and each cooper could take an apprentice, although only a minority did so. As most apprentices were the sons of coopers, the question of wages was settled by the father keeping his son in board, lodging, and clothes and giving him what pocket money he thought fit. Of course, some were treated better than others.

A master's apprentice usually had no wages for the first year, but was paid 4s. weekly the following year, and then, if able to make casks without assistance, received two-thirds of his earnings, the master taking the other third. If unable to work alone, he might be put under a cooper as improver at an agreed wage until proficient. To-day apprentices are bound for five years and start with an agreed wage, increasing every year.

On the day an apprentice completed his seven years it was the custom for him to have a 54-gallon cask over the fire ready for trussing up at twelve noon. This was removed from the fire or cresset and the newly pledged apprentice placed inside while the hoops were driven home by all the coopers that could get near the cask. As long as possible was taken over this process; hoops were frequently knocked off "by accident." The cask was then pushed on its side and rolled about a bit, then the victim was removed by his legs, and a number of coopers tossed him up in the air and caught him a number of times in a manner similar to tossing a man in a blanket. It was easy for an unpopular apprentice to be dropped once or twice in this operation. At the conclusion of this ceremony 30s. was given by the ex-apprentice to the men to be expended on liquid refreshment.

There were three classes of coopers:—

(i) Brewers, who made casks for beer, wines, or spirits.

(ii) Dry coopers, who made casks to hold dry goods, such as apples, potatoes, and dozens of other articles.

(iii) White-work coopers, who made dairy utensils, churns, tubs, buckets, &c.

On being engaged by a foreman, a craftsman was allocated a "berth" in the cooperage, containing a block, *i.e.*, a log fixed in the ground, and a bick-iron to rivet his hoops on. He would stick his axe in the block and then come and go as he pleased; no other cooper would use his berth. If a cooper left and went to another cooperage, his apprentice went with him. Working hours were usually from 6 a.m. to 6 p.m., but coopers were not tied down to these; work was generally paid for by the "piece."

Coopers wore plain leather aprons; blacksmiths had theirs fringed at the sides to show their greater importance. The latter also are said to have preceded the coopers in guild processions to show this.

Method of Working.—A brewers' cooper was told by the foreman what size casks to make. He then fetched from the sawmill enough staves and "heading" to make three casks. If there were not enough staves ready he had to put his number on a board and wait his turn.

The cooper sawed the staves to the required length, and shaped them by first chopping and then shaping the back. He next hollowed out the inside and afterwards jointed the sides on a jointer or plane. This was about 5ft. 6in. long, one end resting on the floor, the other supported by jointer legs. Coopers, unlike carpenters, hold wood they wish to shape and push it down the plane. When enough staves were dressed or shaped, they were placed in position in an iron raising hoop, a wooden hoop called the "over-runner" was dropped on and tightened. The cask was then placed over a cresset filled with shavings on fire. When the staves were warmed through the over-runner was driven down to the bottom. Another hoop, called top end bulge, was driven on, the cask taken off the fire and reversed, and the over-runner driven slantwise, which partly closed the staves. This enabled first a smaller "pitch hoop" to be put on, followed by the bulge, and the quarter, and last the (iron) dingey. The cask was again placed over the fire to set. These wooden hoops were called truss hoops. The next step was to remove the cask from the fire, knock off the end hoops and replace with rounding off hoops. Usually iron hoops were used for small casks, and wooden hoops for larger sizes.

The tops were then rounded off (or shaped) with an adze, and a jigger, or in modern days a chive, prepared the inside for the "croze," a tool used to make the grooves to keep the heads in position. A small hole was made just below the groove with the point of the compasses, which were adjusted so that by fixing one point in the hole and rotating them round the groove six times till the other point exactly reached the starting point. This gave half the diameter of the head.

The head was then scribed with the compasses, roughly shaped with the axe, trimmed with heading knife, compassed again, and cut to correct size. Tops and bottoms of casks are called heads. The outer pieces are called "cants" and the middle pieces "middles." Cants are cut so that the head is a little wider across than lengthways of the grain; this keeps the cask in better shape and allows for shrinkage.

The pieces are then bored and a split rush inserted between the joints, dowelled, and joined together. After the heads were cut to size hoops are (or were) loosened, heads fitted into the groove, permanent end hoops were fitted, the outside of the cask shaved or buzzed, bulge hoops fitted and driven to proper position.

Tools.—Most of the tools are practically the same as they were hundreds of years ago. In the old days a copper's kit, or set of tools, consisted of saw-tub, saw, jointer legs, axe, backing knife, hollow knife, heading knife, jigger, topping plane, dowelling bit, compasses, croze, and a shave or buzz. It was the custom for the employer to provide hammer, driver, punch, jointers, bick-iron, and truss hoops.

The oldest croze remembered was a saw croze; they are still in use for white work. Various forms of hawks-bills followed and finally the patented hawks-bill now used. About the same time patented chives came into use, also improved shaves for shaving the inside of casks.

At the present time nearly all brewers' and cider casks are made by machinery, so most coopers are employed upon repair work only.

A cask is said to be a "Lord" when the staves are so fitted that it is lop-sided. It is "cock-jointed" when the staves have the same bevel along their whole length. This bevel must be greater at the ends than in the middle, or the cask will have the centres of the staves tending to curve outwards. In olden days iron hoops were straight. Large casks were "knocked down," or taken to pieces after the staves had been numbered. They were re-erected where required.

Coopers' Tools

Adze: chequered adze.

Auger.

Bick-iron or anvil.

Billy: a piece of iron rod or pipe bent at a right angle. The shorter end was put through the bunk hole and used to keep the head from dropping down into the cask while it was being placed in position.

Bits.

Block-hooks: iron pins in the angle of which a stave was placed when being "shaved," inserted into a heavy block of wood.

Brace, or dowelling stock.

Bradawl.

Buzz: similar in shape to a shave, but the blunt knife is at right angles to the handle.

Calipers.

Caulking iron: for opening a space between each stave in turn and the head when caulking the casks.

Chisels.

Chive (pronounced "chiv"): a later tool used to smooth the inside top of casks before the head is fitted.

Croze: for grooving (pronounced "groving") the cask for the head to be fitted.

Downright.

Drawing knife: commonly called a heading or backing knife.

Drivers: used with mallets to drive the hoops tight.

File or rasp.

Flogger: a piece of hornbeam or other hard wood, about 2½ft. in length, used for hammering the top hoop into position. A length of iron bar was sometimes used for the same purpose.

Gimlet.

Hammer: this has a face, *i.e.*, hitting end, called the pane, and the splay.

Heading swifts: for smoothing the heads (tops and bottoms) of casks.

Head-stand: a kind of easel with two legs in the same plane with a strip of wood fixed across about 6in. from the bottom, forming a slot into which the head is fixed when being shaved. The top of the stand rests against the thighs when in use.

Hollow knives: for hollowing out or shaping staves.

Hone.

Horse: a bench with wooden vice on top, worked by a foot lever.

Jigger: for smoothing the inside tops of casks before heads were fitted. The chive succeeded this.

Jointer: a long plane, one end supported by two legs, the other resting on the ground.

Knife (horn handled).

Mallet (wooden).

Measuring iron: for measuring the amount of liquid in a cask.

Pencil.

Planes—topping plane: a curved plane for smoothing the end of staves when in position.

Pliers.

Race or scribe: used for numbering casks, &c., and for making the cooper's mark.

Rivets.

Rule.

Rushes: for caulking.

Saw-setter.

Set-square.

Shaves: Bottle: for very small casks; inside; outside; spokeshave; tub and bucket shaves. Shives: stoppers for bung holes; spanner (adjustable); wire twister.

The Craft of Wooden Pump Making

Mr. W. Rose, in "The Village Carpenter," 1937, has a chapter upon this skilled and sometimes dangerous craft. Mr. T. Barber, now of Cardiff, has largely supplemented the valuable record in this volume and went to great trouble in making some fine models of tools his father used, and which Mr. Barber believes he invented. Mr. Barber, sen., was a Lugwardine craftsman of some local note, and his son (born in 1861) began work at the age of nine as his assistant, but left for another occupation when fifteen years old. Four generations of the family had practised the mystery of wooden pump making.

The total weight of the tools used was about 2½ cwt. and they were taken to the site required upon a hand-made truck, which in itself seems to have been a source of amusement to onlookers. The tools were old when Mr. Barber first remembers them. Upon arrival at the place where suitable trees were growing, the first task was to fell these, and square the sides; the work of boring then began, and it was necessary for this to be done quickly, otherwise the trunks might split and be useless. The upper section of the pump was usually 10ft. to 12ft. in length, one side being about 2in. wider than the other for about 2ft. from the top. The slot for the handle was cut in this.

Into the centre of each of two sides a nail was knocked for the sighting string. A plumb bob

was used to mark the centre line at the end and a square placed at right angles to mark the exact centre. A circle 2½in. diameter was drawn around this point. This was repeated at the other end. A gouge then cut in for 1in. for the auger to start, which was secured to the rod, some 9ft. 7½in. long (without the auger) with a taper key. A "horse," a crooked limb of a tree, fitted with two legs, and the centre morticed for a slide with a "U" top, was then placed at the correct distance from the trunk, the slide adjusted and fixed with a wedge. Each tree to be bored was fastened with dogs to one of the other logs in turn, one end being raised as high as convenient, so that the weight of the auger would ease the labour of boring; when in good condition the auger would "draw itself in." Mr. Rose says that his father's workmen had the log raised horizontally on trestles. Specimens of the auger rods weigh about 56 lb.

A shell auger (now an obsolete tool) was used as this went straight; screw-pointed augers were said to follow the grain and never run true. To get the auger in exact position the end was put in the hole gouged for it, and a sighting string taken along the whole length of the tree and up to the tiller or handle. This was given a quarter turn and then sighted along the other side. After boring 3in. or 4in. the auger was withdrawn and well greased; much grease was used, and the tree was bored from each end. A 3in. auger was used after the 2½in. Mr. Barber says his father invented a block auger and mandrel.

Upon large estates the sawyers usually cut down and squared the trees, always oak, in such places as Stoke Edith and Holme Lacy, where sometimes four or five trees were required. Oak boring was noisy and could be heard at a distance of 2 miles.

The bottom or suction section was 16ft. to 18ft.; if longer, a vacuum was said to cause the handle to fly up. It was bored with the 2½in. auger and had a taper bore in the top for the valve. The upper sections were usually bored with a 4in., sometimes 5in., auger, the bucket worked in the second from the bottom, and if the owner chose to pay 15s. extra this was fitted with a copper liner to lengthen the life of the bucket leather.

The lengths were jointed with spigot and faucet joints tapered from 7½in. or 8in. to 9½in. The faucet end was banded with 1½in. by ⅜in. iron. After joints were cut, 3in. was taken off each edge of the tree with notches for the rope for lowering. The tool used for cutting the faucet had three legs with a hole in the centre for a bar 3ft. long, threaded for about half its length. An adjustable cutting tool was fixed in a slot. The legs were centred and driven into the end of the tree. A hole 5in. diameter and 1ft. deep was cut out in about half an hour. A somewhat similar tool was used by wheelwrights to cut out the hub of a wagon wheel for the "boxes" to be fitted when wooden axles were made.

The spigot tool was made by Mr. Barber, sen. It had a guide about 18in. long to fit the 2½in. bore, and two loose sleeves to fit the 4in. It was really a strong rotary spoke-shave, and was used after the end of the tree was roughed down nearly to size, and would cut a taper joint as true as if turned in a lathe. Elm and chestnut trees were also used in pump making, the former nearly always for the top section, which was planed and jowled worked in the set-off. The handles were of ash for pumps up to 20ft. The pin holes were burned in them. Deep pumps had iron handles with hardened steel bushes and wooden pump rods 40ft. or more in length. They were light in water and assisted the downstroke of the handle; they would fly up 10ft. or 15ft. when detached from it. An example from "The Sheepcot," Lugwardine, in Hereford Museum, measures 43ft. 11in. It may have been made by a member of the Barber family.

Buckets and valves were turned in a home-made lathe of oak or elm, about 5in. long, centred with dividers, bored with 1½in. hole, and roughed down to size with a chopper. Buckets and valves were banded with a light band top and bottom, for the valve had a staple with shoulders resting on the top band and going right through to the bottom, where it was riveted to two small plates. The valve had three grooves turned in it to hold packing. The bucket had a ledge for the leather, which was nailed on with copper nails. The valves could be withdrawn by special rods and repaired without taking down the pump. A Warwickshire bucket in the Museum is 19in. long and is made on a different pattern. One from Lugwardine is made as described and also may have been the work of Mr. Barber's forbear.

Spouts were of cast iron and fixed with four coach screws. They were of Mr. Barber's father's own design to prevent sticks or stones from insertion and were made at Hodge's Foundry in Bath Street.

The work of taking out old pumps was dangerous and tricky. When the well was being uncovered the timbers might be rotten, and care was necessary lest the workmen should fall in. Foul gas might be present, though a lighted candle quickly proved if this were the case. A 7ft. saw-pit roll and levers was placed upon two planks across the well, with five or six turns of a rope around it. The pump was on the further side of this. A man was then sent down the well to put a timber hitch round the bottom of each section in turn. The pump was well shaken to loosen a joint, the levers moved a quarter turn at a time and their position changed, the roll being continually levered back into position.

Wells round Hereford were from 20ft. to 70ft. deep. They were cleaned out with a windlass and an 18-gallon cask with head taken out and a handle fixed. Sometimes twelve buckets full of mud were removed.

The new pump was then plugged at the bottom, four holes bored through it 1ft. from the end and nails driven across these to stop frogs from entering. The first section was let down under the pit roll, the reverse way from drawing up an old one. A pot of boiling tallow mixed with resin and whiting and some flannel were let down on a small cord. When the second tree was lowered to within a few feet of its position a youth was sent down the rope. He got the bottom tree between his legs, his back tight against the well, and anointed the spigot joint with the soaked flannel, which was carefully and evenly wound around it. The faucet end was guided into position as it was lowered from above. Each joint was fixed in a similar manner. When the top one was fixed the youth stood upon the pump, the pit roll was lifted and bumped down to drive the joints well home, though it was claimed that three or four together would not move more than ½in.

The valve was then packed with flannel tacked on to keep it from unwinding, soaked in hot fat and let down with a small line and hook. When nearly in position the line was withdrawn and a special weight attached to a strong cord rammed it tightly home. The bucket was let down on one or more wooden rods; if more than one, they were halved and jointed and secured with two wooden pegs and two small iron bands. When the rod was fixed to the handle and the work was complete, half a bucket of water was poured down, the handle worked sharply for several minutes, when water should flow if the work was well and truly done. English country craftsmen rarely made a mistake, and the proof of this piece of craftsmanship came after the water had risen. The pump was left idle for a few minutes, and if, when the handle was raised, a few drops of water came from the spout, the job was satisfactory.

The system of jointing the trunks described by Mr. Rose was different from that customary in Herefordshire and Warwickshire, the positions of the spigot and faucet ends being reversed. A small leather valve called a clack was placed on the top of the bottom spigot before the next section was lowered into place.

The craft really came to an end shortly after 1876, when iron castings from Stourbridge supplanted wood, though repair work went on for some years later.

CANADA'S COINAGE CHANGED.—The now-familiar threepenny bit has a first cousin in Canada, where a "black-out nickel" has been put into circulation in certain industrial centres. The new coin is of copper and zinc, about the size of the old 5-cent piece, and has twelve sides, making it easily distinguishable to the touch.

R.E.M.E. and the Battle of Egypt

IN Journal notes of May 8th and June 12th we recorded the creation of a new engineering corps in the Army, which came into being on June 1st and is named the Royal Electrical and Mechanical Engineers. It consists of the entire engineering side of the R.A.O.C. and all the maintenance staff of the R.A.S.C. (except those serving in transport platoons and workshop platoons within the R.A.S.C. transport companies), along with a portion of the mechanical maintenance staff of the Royal Engineers.

At a conference which took place in London last week, one of the Senior Officers of the R.E.M.E. gave some particulars of the part the new corps played in the recent Battle of Egypt. That battle, he said, had conclusively proved that closer co-ordination within the Army had been achieved. Never before in its history had the Army fought with more efficiently maintained weapons. Guns which developed faults, tanks which broke down, motor lorries which stalled, wireless sets which gave faulty performance, and range finders which were inaccurate, all helped to reduce the fighting efficiency of an army, but it is on record that these things did not happen in Egypt, because of the magnificent work of the R.E.M.E. corps. In that historic battle the greatest barrage of the whole African war was laid down, and our tanks never hesitated in their chase of the flying German mechanised forces. Endless columns of the British Army were kept rolling along, even under conditions of transport worse than any the Army had previously been called upon to overcome. Indeed, the creation of the R.E.M.E. had meant more than the mere formation of a new corps, with the introduction of a new badge and a new title for the common solider. It had brought into existence a new form of Army organisation in a branch of war which earlier had most successfully been exploited by the Germans. Clever planning, along with the skill and adaptability of the R.E.M.E., had given to the Eighth Army, and would provide for other British Forces, a maintenance and repair organisation which was second to none in the world.

It was satisfactory to learn that both the Canadian and the American Armies had adopted the new ideas which had been embodied in the new corps. It was pointed out that the officers and men of the corps had to be combatant soldiers and rough soldiers. In providing the essential services which had kept the Army at its highest fighting efficiency, the corps had fully deserved the share of honour with the officers and men of the 51st Highland and the other divisions, the R.A.C. and the R.A., which were the pride of the victory won in the Battle of Egypt.

Industry and Post-War Reconstruction

FOLLOWING the statement on post-war reconstruction by Sir William Jowitt, in the House of Commons last week, a proposal has been made that industry should have a joint committee to consult with him on the matters which he is studying on behalf of the Government. The joint committee, it is stated, will consist of representatives of the British Confederation of Employers, the Federation of British Industries, and the Trades Union Congress. This proposal has been brought before the Trades Union Congress, and it has been decided to approach the Minister, in association with the Employers' Confederation and the Federation of British Industries, in order to discuss the possibility of giving effect to the plan. The purpose sought, it is stated, is to bring the collective views of industrialists, both employers and workers, to bear on the Minister's inquiry before the shaping of policy begins, in order that the Government may be fully informed of the opinions of industry, more particularly when there is agreement between the employers and the workers. We are given to understand that the two organisations of employers are ready to co-operate in this matter,

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DECEMBER 11, 1942

VOL. CLXXIV No. 4535

Contents

THE ENGINEER, December 11th, 1942 PAGE

A SEVEN-DAY JOURNAL ... 471

LEADING ARTICLES—
FAST FIGHTERS ... 480
ENGINEERS AND MONETARY REFORM ... 480

SPECIAL ARTICLES—
DEEP TUNNEL AIR RAID SHELTERS. No. III. (Illus.) 472
INSTITUTION OF CIVIL ENGINEERS ... 474
REPAIR AND SALVAGE OF AERO-ENGINES. (Illus.) ... 475
BRITISH MERCHANT SHIPBUILDING PROGRAMME IN NORTH AMERICA, 1941–42. No. II ... 482
CIVIL ENGINEERS AND THE BUILDING INDUSTRY ... 486
INDUSTRY AND POST-WAR RECONSTRUCTION ... 479
RAILCAR OIL ENGINES IN THE ARGENTINE. No. IV. (Illus.) ... 483
R.E.M.E. AND THE BATTLE OF EGYPT ... 479
SOME OLD TOOLS IN HEREFORD MUSEUM ... 477

LETTERS TO THE EDITOR—
PROGRESS AND INDUSTRIALISTS ... 481
ORGANISATION FOR SOCIAL RECONSTRUCTION ... 481

LITERATURE—
BOOKS RECEIVED ... 482

OBITUARY—
HUGH PURDY ... 482

NEWS AND NOTES—
FORTHCOMING ENGAGEMENTS ... 490
MARKETS, NOTES AND NEWS ... 489
NOTES AND MEMORANDA ... 490
SIXTY YEARS AGO ... 488
SOUTH AFRICAN ENGINEERING NOTES ... 487

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CHANGES OF ADDRESS

**** Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both old and new address,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

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FAST FIGHTERS

So frequently does one read of some new wonderful performance in speed or climbing capacity of the latest fighter aircraft that one cannot but wonder whether the pace can last. It is not merely that speeds have risen since the last war from the neighbourhood of 150 to 400 miles an hour, but that nearly the whole of this immense advance has been concentrated in the last ten years. The increase in engine power alone has not done this, since to force the aeroplane of the day from 150 to 400 miles an hour would require between ten and twenty times the power, whereas the actual improvement, great as it is, would not be much over four to one. Most of the change has been due to improvements in the airframe, partly to the drastic alteration from biplane to monoplane construction, with its absence of struts and therefore of wetted area and of aerodynamic interference in the streamline flow, partly to the use of undercarriages that can be tucked up, and partly to the meticulous cleaning up of all excrescences, including miscellaneous instrumental gear formerly carried outside. In a lecture given before the Lilienthal Gesellschaft just before the present war, Dr. Heinkel, the aircraft designer, estimated that, whereas six years earlier nearly 40 per cent. of the total drag was caused by struts, exposed landing chassis and the like, by 1938 the whole of this had disappeared. So aerodynamically clean are aircraft now that even the gun mountings and turrets do not usually reduce top speed by more than a few miles an hour.

It is worth considering how much further the aircraft designer can go. Little of such a character as instantly to strike the eye seems left to him, but there is a good deal that is less obvious. Rivet heads, when not finished flush, cause an extra drag that can and must be avoided; new wing shapes in which the air stream follows the contour further back than used to be the case are a vitally important field of study, since success in this direction at once puts down the drag. Bold pioneers, in Germany as well as elsewhere, have experimented with methods of sucking the turbulent air into the wing, or, in the alternative, of blowing it backwards, in order to reduce still further the wing resistance which accounts for some half of the total resistance of the modern aircraft. Engine power is being steadily pushed up at the same time, and the end of that endeavour is far from being in sight. But with all these possible developments and others which cannot be mentioned, and some still no doubt to be discovered, a very steep hedge is being approached. If the drag invariably rose at no steeper rate than the square of the speed, a change from 400 to 600 miles an hour would merely lead to a drag increase in the ratio of 16 to 36, but owing to the close approach of the higher of these two speeds to the velocity of sound—the highest speed at which any sudden disturbance in the air can move itself away—the actual increase in drag, as many wind tunnel tests have shown, is likely to become tenfold, and no ordinary increase of engine power, however substantial in itself, can surmount such a barrier, especially when the airscrew efficiency is known to drop substantially once this range of speed is entered. The search for a way around or over this hedge is assiduous.

The new German fighter, "FW190," has shown a remarkable capacity for climbing fast, and the Junkers "86" has an unusually high ceiling, but even these improvements, considerable as they are, have not given either craft appreciably greater safety when in combat with the R.A.F. Many "FW190s" have been shot down and we note that over the African fighting zone at least three Junkers "86s," although flying close to their lofty ceilings, have been engaged and destroyed by our indomitable "Spitfires." An exceedingly high ceiling may indeed be useful for photographic aircraft and well worth striving for, but for bombers hardly at all, since little surplus lifting capacity is possessed by any aircraft built for stratospheric flying. Despite, therefore, the technical skill of the German designers, we have ample reason to feel confidence in our own men—designers, constructors, and flyers alike. What the future has in store is always and everywhere carefully concealed, but each time the curtain is drawn slightly aside we realise how effectively each move of the enemy is matched, and more than matched, by our side in this Homeric contest. In air warfare quality counts even more than quantity, but the lead in quality once assured, the advantage of overwhelming numbers is one which steadily mounts. The crisis of the war seems to be close upon us, and as engineers we are justified in feeling as well served in the technical efficiency of our fighting equipment as we are in the Air Force that so confidently uses it. In the severe air fighting that lies immediately ahead the performance of the R.A.F. will, we feel sure, to borrow Mr. Churchill's modest but confident phrase, be "well worth watching"!

Engineers and Monetary Reform

IT IS, we trust, no disparagement of the lecture which Lord Sempill delivered at the Institution of Civil Engineers on December 3rd to say that its substance was of no greater significance than the fact that the Council of the Institution had agreed that it should be read under its ægis and in its hall. That fact is eloquent of the new spirit which is moving engineers to take corporate interest in affairs which have until quite recently been held to be outside their proper function. Hitherto engineers, as represented by their Institutions, have, with rare exceptions, devoted themselves solely to the science and technology of their crafts. As individuals they concerned themselves with economic and political matters only as all good citizens do; but they did not attempt to express opinions upon affairs of national importance in a corporal capacity. With diffidence we venture to flatter ourselves that THE ENGINEER has done not a little to awaken them to a sense of the responsibilities in national affairs that reside in them by reason of the importance of their varied occupations.

But whilst we have constantly urged engineers to pay attention to the problems of economics as they affect and are affected by their works, we would hesitate to say that it is within their competence to handle questions of national and international monetary reform, which was the theme of Lord Sempill's lecture summarised on another page. On such questions they have no more pretension to exact knowledge than other people, though one might trust them to attack them with more reason and logic than is often found amongst reformers who are apt to allow emotions to bias their judgment. Nevertheless, they cannot, we suggest, claim any special right to be heard on them. Each individual engineer should, of course, form his own opinion from the facts, and, like any other citizen, express his views or use his influence in ways that are open to all, but financial reform is a highly contentious and combustible subject, which is but little, if any, more suitable for the corporate action of engineers than for those of any other profession. It differs from many other subjects

upon which engineers have an obvious and particular right to be heard—such matters, for example, as education from all aspects, the patent laws, registration and status, economic aspects of the location of industries, and many others which are likely to arise in the forging of the new commonwealth of the world. In the social and industrial changes which are foreshadowed in the period of reconstruction, it will, as Lord Sempill urged, behove engineers to watch those things which affect their own interests, and to endeavour to assist the decisions of Governments so that the greatest public good may be derived from their works.

On matters of social importance which fall within their particular competence, engineers have a greater responsibility than any other class of men, for more may turn upon the right use of their work than of that of any other single class. This now acknowledged fact is excellently presented in a letter by Mr. J. H. Ferguson which is printed to-day in our correspondence columns. Civilisation, in the modern sense, is the child of the engineer. At the moment it is imperilled by the misuse of the arts he has invented, discovered, and developed. When the shards of war have to be re-wrought to serve an era of peace, it will be the duty of engineers to apply their special knowledge to the new problems, and to endeavour to guide their undertakings of all kinds so that mankind may get the greatest benefit and the least harm from them. They cannot leave these questions to the unguided will of politicians, who, too often, have shown as little understanding of engineering as sympathy with it.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

PROGRESS AND INDUSTRIALISTS

SIR,—"There are conservative people who resist change, but we submit it would be difficult, if not impossible, to name even a dozen cases in which they have succeeded in holding up progress for any considerable time" (leading article in THE ENGINEER, November 27th, 1942).

That statement deals with a subject which very few engineers have studied. Would you allow me to discuss it, for, as it stands, is it not apt to lead to unjustifiable complacency?

When a new mechanism has been produced and is in use, the industrialist and his engineer designer make great efforts to improve it in detail, especially where the machine is subject to criticism by the buyer. But it is impossible to design before the invention has been produced, for a new invention is something which has not yet been done, and designs are simply particular applications of inventions.

Where an inventor, or an inventor and his (speculative) supporters, is able to produce his invention and sell his new machine under guarantee, a few enthusiasts take it up and show its worth. Then the rest have to follow suit or lose business. But is it not the case that the members of an industry, as an industry, only accept a beneficial change from necessity and not from attractiveness till it is established?

The turbine was by no means welcomed (see a letter in *Engineering* about 1907, from Mr. Brown to his son, of Brown Boveri, and the Symposium of Papers on Invention, Inst. Mech. E., 1934).

Apart from a few enthusiasts, the coal master only adopted the mechanism of mines when necessity drove him to it.

Road transport would not look at producer gas till the great need arose. Even now it is only getting it, due to the determination of a few leaders.

The railway mechanical engineer is not a "manufacturing" engineer, but an "operating" or maintenance one, and he works for a director who is both uneducated in engineering matters and apt to be of the "trustee" rather than the "enterprising" type. The railway companies are the only real locomotive manufacturing engineers, and the railway mechanical engineer designs locomotives for his own company's use and not for the competitive market. Consequently progress has been held up for a very considerable time, and it is possible to give your round dozen cases from this machine alone [Mr. Macdonald gives a list drawn from locomotive practice, but every one of the inventions he names has been tried and found wanting or is in use where it suits the circumstances. We should regard them as supporting our contention.—ED. THE E.]

Do I not make my point? Before worth-while progress can be obtained, the inventor must be offered an inducement to tackle problems of invention. On some occasions I have seen the goal, but it has taken two or three years' work to find the road to it, and then that road had to be travelled.

Even forty years ago most of our engines were built by rule of thumb; consequently, when a new method was found, it could compete with little development. To-day our established machines are built to better rules, and have had their troubles eliminated by experience; the new method has to start further back than the one in use, and has to be brought up to at least equality before it can be brought into use. Who is to do that work and bear the expense of it: the inventor, or the industry which will obtain the benefit of it?

If the members of an industry wish to obtain better methods of working, they can get them by making use of invention, but to do that they must go to the inventor, whether they like it or not, and they must give him a reasonable opportunity to develop his inventions. Mr. Thompson, in his recent Presidential Address, Institution of Mechanical Engineers, showed how we are indebted to the Americans for the recent advances in boiler practice, *i.e.*, they and not us have given the inventor his opportunity. Mr. Stanier's address last year showed where the steam locomotive has landed us as regards development through barring the door against the inventor.

An invention is not made by deduction or reasoning, but through the toil of acquiring knowledge first, and then it comes through revelation, inspiration, intuition, or insight, *i.e.*, some action of the un-, non-, or subconscious part of the brain revealing to the conscious part what to do, and at the same time giving convincing proof that it is the right thing to do. We do not yet know enough about psychology for the inventor to convey this proof to other men. We "think" that we can "consider" new inventions by the use of reason or deduction, but as they were not made that way we cannot do so. Consequently, when a technologist reports to a business man on an undemonstrated invention, and sometimes a demonstrated one, the two men are working at cross purposes, and I suggest that such, the common, procedure is holding back progress to a considerable extent.

Why is a research worker considered to be capable of examining new inventions? His job is to measure known things (Sir Dugald Clerk), and he has practically no interest in the practical application of inventions. The engineer has.

SYMINGTON MACDONALD.

Edinburgh, December 3rd.

ORGANISATION FOR SOCIAL RECONSTRUCTION

SIR,—Your very excellent and pertinent Editorial in THE ENGINEER of December 4th, entitled "After the War," gives rise to an intriguing question. I refer in particular to the following sentence: "Yet it must be agreed that everything cannot safely be left till the hour strikes, . . . we must have some organisation ready to deal with the immediate problems."

How very true and vitally essential! But the question arises: Who shall prepare the organisation; who shall do the planning? Can it be left to what I will without disrespect refer to as "the old gang"; the politicians, old or new, of the same calibre as of old? It is, to say the least, to be doubted that they will do any better than the last time they were left to clean up the mess after a period of slaughter and chaos.

Shall I be correct if I suggest that any successful organiser in any human undertaking must be a person of special qualifications, calling for the highest form of intelligence? What is the highest form or kind of intelligence? Psychology tells us that intelligence is of three distinct kinds: The abstract, having to do with ideas; the mechanical, having to do with things; and the social, having to do with people. Any individual possessing the three kinds in a high degree must be said to be a highly intelligent person.

I ask, Have we a statesman or a politician to pass the test? We may have, but, if so, I do not happen to have heard of him.

Amongst all the numerous professions, in which are the three kinds of intelligence essential to success? An engineer preparing the plans and directing the work of constructing a great dam, or bridge, or dock, or railway, or road in difficult country must be a man of ideas; he must not only be able to produce ideas of his own, but have that sort of receptive, analytical, and discerning mentality that can accept, analyse, and pass wise judgment on problems that crop up and the new ideas to solve them. He is of necessity a master of things, tools, plant, and materials. He has to handle often thousands of men of various races, creeds, and colours, not to mention mentalities. He must be a born organiser; he must have all that it takes to carry out successfully the most difficult tasks that can confront a human being. Generals and admirals having to do with ideas, things, and men, can and do make catastrophic blunders, but personally I have never heard of a great civil engineer who has made any.

Can any of your readers or you, Sir, find or point out any body of men better qualified than scientifically trained engineers for the enormously difficult task of planning the New Order? We surely must not be so foolish as to imagine that because the so-called capitalistic system has let us down, the men who by circumstances have been forced to be leaders in that system, are unfit to plan and direct the New Order. After all, amongst them they have proved that they have the brains and energy and whatever else it takes to accomplish great things, as, for instance, to put Britain where she was before the politicians let her down.

I am not so foolish as to suggest that engineers should be the only ones to plan the New Order, but they should certainly play a prominent part. We have men of brilliant attainment and undoubted integrity in other walks of life, as, for instance, H. G. Wells, Dr. Joad, Sir Stafford Cripps, and Sir Richard Acland. The last two should not be classed as politicians.

As economics in any New Order, to have a chance of survival, will have an entirely new meaning, the old-time economists will be worse than useless. Let the engineers plan the new world, but for heaven's sake do not make it a mechanical one; let it be a living thing, giving the utmost possible freedom to all peoples and the widest scope by equal education for all with the opportunities for self-expression.

J. H. FERGUSON.

Wellingborough, December 8th.

Obituary

HUGH PURDY

IT is with deep regret that we have to announce the death, on December 3rd, after a very short illness, of Mr. Hugh Purdy, a director of Buck and Hickman, Ltd.

Mr. Purdy, who was sixty-six years of age, served his apprenticeship with the Pratt and Whitney Company, of Hartford, Conn. He had been connected with Buck and Hickman, Ltd., for more than forty years and was also a director of the E.N.V. Engineering Company, Ltd., of Willesden. He was one of the pioneers in the introduction of American precision machine tools to this country and to the Continent, and did much to foster closer co-operation between machine tool manufacturers of this country and America. He was a Member of Council of the Machine Tool Trades Association for more than ten years and served on the Executive for eight years. His work in connection with Exhibition Committees and the Tariff Committee will be well remembered by all concerned. He was also, in the earlier days, a member of the Advisory Panel on Imported Machine Tools to the Controller-General.

He had not been enjoying good health of late, but his sudden death will come as a shock and will be regretted by all with whom he came in contact during his long association with the machine tool industry.

BOOKS RECEIVED

Jig and Fixture Design. By H. T. Davey. Maidenhead: Percival Marshall and Co., Ltd., Cordwallis Works. Price 3s. net.

The Steam Locomotive. By Ralph P. Johnson. New York: Simmons-Boardman Publishing Company, 30, Church Street. Price 3·50 dollars.

Constitution of Alloys Bibliography. By J. L. Haughton. London: Institute of Metals, 4, Grosvenor Gardens, S.W.1. Price 3s. 6d. net.

Essential Metallurgy for Engineers. By A. C. Vivian. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 8s. 6d. net.

Now or Never? Financial Principles in Relation to Present Requirements. By C. Marshall Hattersley. Mexborough: S.C.C.C., Greno House, Swinton. Price 6d. net.

Drainage and Sanitation. By E. H. Blake. Sixth edition, revised by W. R. Jenkins. London: B. T. Batsford, Ltd., 15, North Audley Street, W.1. Price 15s. net.

The Theory and Practice of Heat Engines. By D. A. Wrangham. London: Cambridge University Press, Bentley House, 200, Euston Road, N.W.1. Price 50s. net.

An Introduction to Fluid Mechanics. Second edition. By A. H. Jameson. London: Longmans, Green and Co., Ltd., 43, Albert Drive, S.W.19. Price 12s. 6d. net.

The British Merchant Shipbuilding Progamme in North America, 1940-42*

By R. C. THOMPSON and HARRY HUNTER

(*Continued from page 459, December 4th*)

COMPARISON BETWEEN U.S.A. MAINLY WELDED VESSELS AND BRITISH MAINLY RIVETED VESSELS

IT has already been published that the man-hours required to build these vessels in the U.S.A. are about double the number required in this country, and great credit has accordingly been paid to our shipyard workers. The shipyard workers are also known to be working really well on the other side of the Atlantic, so that it is natural that one would wonder whether the high number of man-hours required in the U.S.A. is due to the fact that they are building welded ships, and whether there are other contributory factors or other explanations. An average figure for this particular type of ship here is about 336,000 man-hours' direct labour. This includes installing the machinery, also the electrical installation. It also covers all blacksmith work, some of which is sub-contracted in U.S.A., all plumber work except the cabin heating installation, and it includes all joiner work, whereas, in many cases in U.S.A. the furniture is bought outside. The figure does not include upholstery work or bituminous work or the manufacture of such things as ventilator cowls. The only corresponding figure so far published for Canada, and which referred to one of their first ships, was about 600,000 man-hours. The early U.S.A. figures were generally rather more, but after twenty ships the figure for the Todd-California yard was 510,000 man-hours. More recently, however, we have learned that the famous vessel built by Henry J. Kaiser, in the remarkable time of fourteen days, involved only 375,000 man-hours, and further improvement is expected. These figures are for direct labour only, so far as can be ascertained, and it appears that indirect labour also involves a very substantial number of man-hours in U.S.A., amounting roughly to a further 20 per cent., compared to an average figure of from 5 to 10 per cent. here. It appears, therefore, that whereas the welded ship requires less steel, it requires more man-power, and that therefore, in all the circumstances prevailing in the United Kingdom to-day, and particularly the shortage of man-power, our methods generally provide a rational compromise between the two factors.

In considering this matter, however, the following points need to be borne in mind:—

(1) The new American yards were designed specifically for the mass production of one particular type and size of ship, whereas existing yards, both here and in the U.S.A., are able to build efficiently a large variety of different sizes and types of vessel.

(2) In America they are building ships with "butchers, bakers, and candlestick makers." Probably in most of the new yards less than 10 per cent., and in some cases only 1 or 2 per cent., of the men had been employed in shipbuilding before. In the case of Todd-California, only a small proportion of the management had been in a shipyard before, and the same thing applied to a greater extent in several other yards. The men in the yards were, however, remarkably keen and intelligent, and soon learned the job, as is proved by the amazing results achieved. Many of the men were, of course, skilled craftsmen, but not in shipbuilding, while foremen and management were used to handling big engineering jobs of various sorts, such as the building of the Boulder and Grand Coulee dams, the latter being the largest in the world.

(3) The remarkable speed of building—the target of at least one ship per berth per month—is probably a most important and fundamental factor.

(4) The equipment for a new shipyard for building welded ships costs less and is more easily obtained than the equipment for building riveted ships. A much larger site area is required per berth for welding, although this may well be offset by the increased production per berth, leaving us with approximately the same output from a given area.

(5) It is much easier to train good welders than good riveters. Females can and do weld, but they cannot rivet. The average man would prefer to weld rather than rivet.

(6) The science of building welded ships is still in its infancy, and improved methods are continually being involved. In this connection it is believed that we in this country are practising more up-to-date hand-welding methods than in America, where much of the thought has been given to machine welding which has at present only very limited application in shipbuilding. Early figures for the Todd-California show that less than 10 per cent. of the total welding was done by machine. Feet/man/day were given as 53 for machine welding and 17 for manual welding. The machine can only be used for straight down-hand work, however. A.C. welding is only used in U.S.A. for machine welding. Hand welding is done with D.C. generators, mostly of the single-operator type.

(7) The question of repairing welded ships requires special consideration. Generally speaking, repairers have been welding for longer than builders, but unfortunately this has resulted in repairers knowing far more about antiquated methods of welding than they do about modern methods. The 200-ampere welding set and bare iron wire are still in some cases the ship-repairers' friends, while both are unknown, fortunately, in shipyards. The fundamental principle followed while building welded ships is so to arrange the sequence of work that contraction while welding can take place. This is sometimes impossible when carrying out a repair. Repairs therefore in a highly stressed part of the ship's structure are going to be very difficult in a welded ship by welding. Pending further developments, it may prove better to do repairs in such areas by drilling and riveting. An example would be the renewal of a stringer or sheer strake plate amidships. If a rectangular plate in such an area were cut out and a new plate welded in, trouble would probably follow owing to the combination of welding stresses and service stresses. This matter deserves the closest study by classification societies.

METHODS OF BUILDING IN THE U.S.A. AND CANADA

Labour.—In both the U.S.A. and Canada labour was available in quantity—there were 12,000,000 unemployed in the U.S.A. at the beginning of the war—having a high average of intelligence and mechanical aptitude with a large proportion of skilled craftsmen among them, although practically none had previous shipbuilding experience. The above should be borne in mind when reading newspaper reports about the building of ships by butchers, bakers, and candlestick makers. Also the yards were laid out for, and engaged on, repetition of the identical ship in quantity, so that men were largely on the same job time after time—an essential to the efficient and quick utilisation of raw labour. With this went an elaborate system of production planning, including very complete breakdown of the plans into component details.

Under such conditions a man without previous experience, but with aptitude, very quickly becomes an efficient worker. In the Richmond yard early this year (1942) when that yard was one of the leaders in rapid building and in economy of man-hours per hull, the total number of employees was about 10,000, of whom 87 per cent. had no experience in shipyards. About 7 per cent. were classed as trainees and 20 to 25 per cent. as helpers. Of about 1100 welders employed, 650 had been trained in the yard, and also large numbers of yard-trained men had transferred to associated yards. In this connection it may be noted that the first keel was laid in April, 1941, and the first launch took place in August, 1941, and thirty ships were launched by June, 1942.

Other U.S. yards had even higher percentages of men with no previous experience, and in the

* Eleventh Andrew Laing Lecture, North-East Coast Institution of Engineers and Shipbuilders. Condensed

case of one large eleven-berth yard, which has set up some recent remarkable building records, the percentage of men with no previous shipyard experience is believed to be over 95. This particular yard launched its first ship in September, 1941, and fifty-four by August, 1942, and the authors recall that the production planning set-up was one of the most complete in the U.S. Most of the men seemed to be able to get started either as journeymen or helpers without much difficulty, often with very little previous experience in their trade. The procedure was for men to apply at the yard, where particulars of their past history were taken, and if the personnel management department of the yard felt they were suitable for a particular trade, things were arranged so that the men could get their union card from the local "business agent."

Regarding rates of pay, the work was mostly done on a time basis, but hourly rates were good and every man is expected to work at what we would call piecework speed. Rates paid on the Pacific Coast yard were as follows:—Journeymen (all classes), 1·12 dollars, or, say, 5s. 6d. per hour; helpers (all classes), 87 cents, or, say, 4s. 3d. per hour; trainees were normally recruited from helpers and went through three stages, each lasting about two months, the corresponding rates being 97 cents, 1·02 and 1·07 dollars. Apprentices and apprentice schemes do not exist. Day shift men worked 48 hours per week and were paid for 52 hours, as over 40 per week were paid at time and a half. Second shift worked 45 hours, and were paid 52, and third shift worked 42 hours and were paid 52. Journeymen's rate on second shift was 1·232 dollars per hour, and third shift 1·288 dollars per hour. Journeymen could be promoted to act as leadermen (similar to our chargemen), when they got 10 per cent. increase. These rates of wages are, of course, associated with a higher cost of living than that which applies in this country. All journeymen, no matter what their trade, got the same standard rate. There was very little interchange between trades, but the sort of thing that happened was that an ordinary labourer would be promoted to a helper in a skilled trade and could soon work up from that to a tradesman if he showed ability. In the U.S. yards they not only have all our "trades," but a few more as well. Their definitions are, however, rather more clear-cut, with the result that demarcation problems are less noticeable.

It should be mentioned that there are only two unions in the U.S.A.—the C.I.O. and the A.F. of L. Any particular firm deals with and recognises either one or the other. Both unions have departments covering particular trades, but any particular firm only has one union to meet, not a different union for each trade, as we have, and the same principle appertains, though to a lesser degree, in Canada. It has many obvious advantages as compared with our system, not the least being the minimising of demarcation problems.

Production.—Beginning with the loft, it was found that mould lofts generally were very much larger than in this country. Special care was taken with the design of the mould loft floor to avoid expansion and contraction due to temperature changes, and this was usually done by laying the usual wood floor strongly constructed and on top of this wood floor a hardwood parquet floor. This hardwood floor was polished, and the lines were marked out in pencil instead of the usual method of a black floor and chalk lines. The object of this was to ensure absolute accuracy, because from this floor templates were made covering every individual part of the ship. Templates were made of specially seasoned timber and in some cases of special paper, while in other cases of sheet metal.

The next process was to cut the various plates and sections correct to shape, and this was nearly always done by oxy-acetylene flame cutting. Many different and elaborate types of flame-cutting apparatus were in use, one of the most notable refinements being the mounting of the burners on floating heads, so that the distance of the burner from the plate was automatically adjusted, and consequently plates did not have to be perfectly flat before burning. The bevelling required to suit welding was usually done in the same manner and at the same time as the cutting process. Flanging machines were usually installed; also the usual shell rolls. Other special machines were provided for the shaping of plates. In this connection, although we build similar ships without furnacing any plates at all, in America they find it easier to make special moulds and furnace or press any plate having an undue amount of shape, thus avoiding the rather specially skilled occupation of rolling plates having a double set, and also ensuring absolute accuracy of the shape of the plates and simplifying the fitting of them into welded structure. Frames were turned in exactly the same manner as here, the furnaces usually being oil fired. It will be seen, therefore, that very little normal shipyard machinery was used, and the whole of what might be called the skilled operation of shipbuilding was really done in the loft.

The next process was the erecting of the various plates and sections into sub-assemblies, which might weigh anything up to about 50 tons, and in some of the yards now very much heavier weights can be handled. These sub-assemblies were designed to avoid turning over as much as possible during the welding operation, which is carried out on skids on the ground. The intention was that enough space should be allowed so that all the sub-assemblies required in the ship could be ready before the berth was vacant, and in this connection it has been found that in the original British yards in the U.S.A. the space allowed for storing the sub-assemblies was not nearly sufficient in relation to the very high speeds of production which are now being obtained. Such speeds, however, were not contemplated at that time, and the original design of the Richmond and Portland yards contemplated an output of thirty ships per annum, whereas actually it appears that the capacity of the Richmond yard is nearly three times and the Portland yard nearly twice the number of vessels originally contemplated. When the berth became vacant, the sub-assemblies were then transported and erected in the berth in accordance with a sequence plan and chart. Alternatives naturally developed as experience was gained, although most of these developments took place too late for adoption in the British contracts.

The bottom shell originally was arranged to be laid out plate by plate in the berth and machine welded on top, hand overhead welding being adopted underneath. Later, sections were laid out on the skids about 60ft. long, and these sections were then turned over to enable machine welding to be done on both sides. The sections were then assembled in the berth and the joints machine welded on top and hand welded overhead underneath. This enabled more work to be done before a berth was vacant. Floors in sections already welded to the tank top on the skids were then put in place. This remained general practice.

Prefabricated bulkheads and side shell bolted to frames up to second deck were next erected. Later, sections of side shell were riveted to the frames on the ground before erection, and to enable this to be done the original staggered shell butts were rearranged so that welded butts in line were adopted. We were rather nervous about having butts in line, but experience does not seem to have justified our feelings.

Hatch-end beams and girders were next erected, followed by sections of second deck already welded to beam. Later, both hatch beams and hatch side girders were welded to sections of deck plating and beams on the ground and lifted into place as units with butts in line with hatch and casing corners. Side shell was next pulled in and faired to the decks and welded thereto and the frame feet brackets welded to tank top.

'Tween-deck bulkheads and 'tween-deck frames already riveted to the sheer strake in sections about 60ft. long were next erected, followed by upper-deck hatch-end beams and girders and sections of deck. The same development took place as regards the attachment of upper-deck hatch-end beams and girders to sections of deck, as in the case of the second deck. Stringer butts were, however, generally kept well clear of the grouped shell and deck butts. Top side shell was then pulled in and welded to upper deck, 'tween-deck frame feet welded, and the ship was then ready for the erection of deck-houses, which were generally prefabricated entirely as units on the ground.

The ends of the ship, *i.e.*, from fore-peak bulkhead forward and from after-peak bulkhead aft, were laid out and built up as pre-assemblies on the ground, the cruiser stern also being made as a separate unit on the ground and the whole of these units were transported complete to the berths. Between these end assemblies and the main 'midship body, however, an appreciable amount of material was assembled in the berth in the form of individual plates and frames as far as the shell was concerned.

The method described above involved the lifting of weights up to about 50 tons, and these weights were generally handled by two cranes of 25–35 tons capacity.

In accordance with the U.S. custom, main engines, boilers, and shafting were installed on the berth, thus enabling the decks to be closed and work amidships to proceed before launching.

(To be continued)

Railcar Oil Engines in the Argentine*

By C. R. PARKER

(Continued from page 466, December 4th)

Spare Part Manufacture.—Wartime conditions have necessitated the manufacture of spare parts in the railway company's shops, which would not normally have been undertaken. This has involved considerable experimental work with the limited selection of materials available. It is satisfactory to be able to record that so far all obstacles have been overcome, and no units have been kept out of service due to any shortage of vital parts.

Actually, shortage of special materials has caused more trouble than lack of plant facilities. For instance, a piece of suitable material to manufacture a crankshaft in one piece is not available, but a built-up shaft could be manufactured if necessary. Fortunately, two crankshafts which had been discarded owing to having been seriously bent in collisions have been recovered and straightened, and are now giving good service. One of these had the end web closed in almost ¾in. At the time of writing these shafts have run more than 180,000 kiloms. since straightening, without trouble.

Locomotive axle and tyre steel have covered most material requirements for such items as injectors, fuel pump parts, gears, small spindles, &c. Cast iron pistons have been designed and manufactured, but these have not been put into service, as a good supply of the light alloy pistons was received before the necessity arose. Cylinder liners have also been made to enable some of the original pistons changed at general overhaul to be reused. So far this has not proved necessary, but in any case it has been decided to adopt the practice of sleeving once the cylinder bores reach a convenient size. By this means it will be possible to reuse old pistons, and will be put into force when the cylinder bore diameter reaches 175 mm., which will correspond to kilometrage of about 1,200,000. Connecting-rods are now being manufactured for trial using axle steel. The section has been improved by better radii, and it is proposed to equip two engines for trial purposes. Meanwhile, on the other engines the original rods will remain in service. The only steel items which cannot be manufactured in any quantity due to shortage of special material are combustion chambers, valves, and bearing and cylinder head studs. Fortunately, a good stock of these items was purchased before the war and small quantities of the necessary materials for manufacture have since been obtained. Cylinder heads, blocks, and valve guides are cast satisfactorily, using a mixture of 30 per cent. pig, 55 per cent. selected scrap

* Joint meeting, Diesel Engine Users Association and Institution of Locomotive Engineers, November 5th, 1942.—Abstract.

iron, and 15 per cent. steel, with the addition of 1 per cent. nickel during pouring.

The most difficult parts to manufacture, which involved considerable experimental work, were piston rings and lead-bronze bearings. These happen to be the parts most in demand. With regard to the piston rings, various mixtures of iron were tried, but suitable material for the pots could not be produced sand cast. Centrifugal casting was then contemplated, but the position was too urgent to wait for the manufacture of a machine. Chills were prepared, and after a few experiments it was found that by casting in pre-heated chills, material of the desired characteristics could be produced. The results with both compression and scraper rings proved far beyond expectation, the material being considered at least as good as that produceed by specialists. It was thought probable when manufacture was first commenced that it would be necessary to change all the rings at partial overhaul. This, however, did not prove to be the case. The mixture used is 40 per cent. pig and 60 per cent. selected scrap iron. Nickel is not used in casting the piston ring pots. To avoid the oil engine casting work interfering with the normal foundry output, a special cupola of 15 cwt. capacity has been constructed from scrap material, with excellent results.

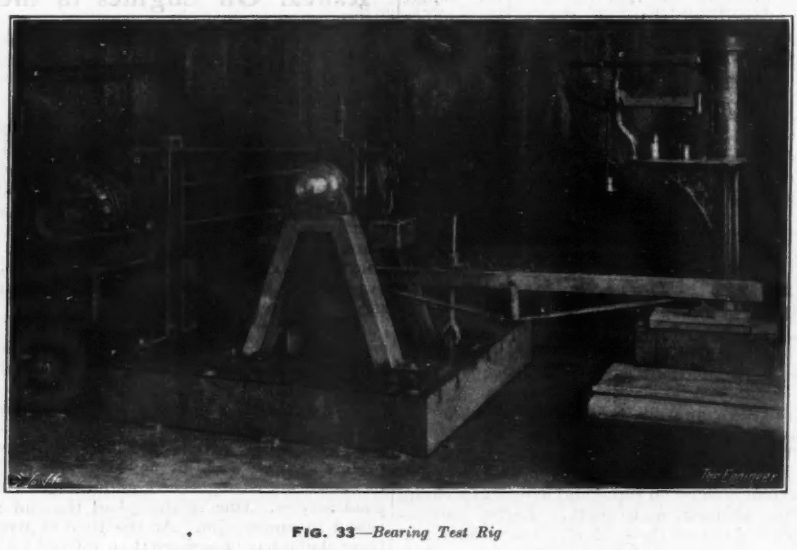


FIG. 33—*Bearing Test Rig*

Lead-bronze bearings were also first cast in sand moulds, but it was soon discovered that chills gave better results. Some anxiety was felt over the manufacture of these bearings, owing to the amount of trouble which had been experienced with those supplied by the makers. In order to determine whether the bearing shells produced were as good from a bearing point of view as those supplied by the makers, a simple test rig was prepared. This is shown in Fig. 33. The results of the trials made are shown in Fig. 34, where it can be seen that all the bearings tested seized with the same load.

The bearing containing 30 per cent. lead was selected as the best, because before stalling the journal it seized only partially about a dozen times. The bearing with 26·5 per cent. lead seized instantaneously. As a result of these tests, it was decided to produce a set of bearings of the following composition for trial in an engine :—

Lead, per cent.	30
Tin, per cent.	4
Nickel, per cent.	1·5
Copper, per cent.	64·5

An engine was fitted and run 100 hours on the test bed. This was followed by 90,000 kiloms. in service, after which inspection revealed the bearings to be in first-class condition. Unfortunately, this engine was destroyed by fire before completing the full kilometrage between general overhauls, but the results obtained relieved all anxiety with regard to the future manufacture of these components. Actually before the engine had completed its first 90,000 kiloms., other engines had been fitted, owing to the shortage of makers' spare parts. The results have been excellent. As the consumption of lead-bronze bearings is considerable, and as it has also been found necessary to supply other railway companies using similar engines with these parts, special jigs and fixtures have been prepared to facilitate production.

Oil Engine Rating.—The first essential for railway oil engines is reliability. With reliable engines the operating costs look after themselves. Experience has proved without question that reliability and the ability to run for long periods between overhaul are closely related to the power demand on the engine. Many engines which have given continuous trouble have been made perfectly reliable by dropping the power to 80 per cent. of the maker's rating. There are, of course, many overrated engines giving good service, because they never have to operate for long periods at the maker's rated output. A good example of power in hand are the results obtained from the 450 B.H.P. oil-electric railcar supplied by Messrs. Armstrong-Whitworth to the Buenos Aires Western Railway in 1934. The unit is not over-powered as regards power-weight ratio, this being only 6 B.H.P. per ton of tare, but by reason of transmission and control design and the nature of the service, the engine operates most of the time at slightly less than three-quarters of its rated output and at a reduced speed. The only trouble experienced with this engine during the first 1,000,000 kiloms. was caused by a leaking rubber ring of inferior quality on one of the cylinder liners. The original valves, pistons, bearings, &c., are still in service. The crankshaft was, however, changed at one of the general overhauls (approximately 800,000 kiloms.) because of slight surface cracking on the journals. The maximum crank-pin wear during this period did not exceed 0·07 mm. The satisfactory performance of road vehicle engines on the road is no doubt due to similar reasons, but when applied to heavy railcar services, where the full rating is required, they are neither reliable nor economical, at any rate within the author's experience. Pressure charging suggests itself as the means of securing reliability without fitting unduly large engines and robbing the payload space, but, unfortunately, the author has had no actual experience of this development to substantiate his opinion. From the user's point of view, the most important point is to ensure an ample power of supply. Any extra initial cost will soon be recovered by reason of reliability, low maintenance costs, and long life.

Rail Traction Engine Design and Railway Requirements.—Rail traction engine design in general seems to follow two trends :—

(*a*) Marine or stationary engines on a reduced scale.

(*b*) Enlarged road vehicle engines.

Many existing road vehicle engine designs have been built up on the lines of their predecessors, the petrol engine. There are three types of engine which cover most railway requirements which can be grouped as follows :—

(1) 100–150 B.H.P., for railbuses, tractors, &c., single working.

(2) 200–350 B.H.P., for heavy-duty railcars, single and multiple unit working.

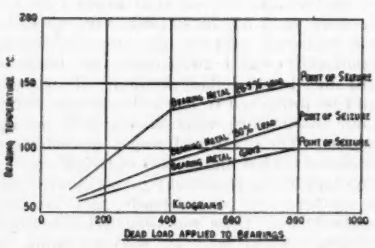
(3) 350–1000 B.H.P., for shunters, locomotives, train sets, and mobile power-houses.

Larger engines may be required for special duty, but in most cases two or more 1000 B.H.P. could be used.

Group (1), 100–150 B.H.P.: The standard road vehicle engine covers these requirements, and with mechanical, electrical, or hydraulic transmission will give satisfaction in railbuses on light service. In light tractors, electric transmission gives the best results.

Group (2), 200–350 B.H.P.: These engines have been developed principally for heavy railcar working, and it is in this category that the "reduced scale" marine engine and enlarged road vehicle designs are most pronounced. This also applies to some extent to the engines of 350–1000 B.H.P. in group (3). For all practical purposes, the notes to follow cover the full range of engines from 200 to 1000 B.H.P.

Dealing with the design in general, the reduced scale marine or stationary engine is more suitable for railway working than the enlarged road vehicle type. This is well demonstrated on the engines discussed in these notes, where the inverted main bearings bolted to the light alloy crankcase are likely to determine the periods between overhauls. The cylinder head construction and form of head joint is also troublesome. Neither of these parts lends itself to easy modification. From the engine user's point of view, the established distance run between overhauls must be based on the life of the weakest engine component. As the unsatisfactory components are improved, so the potential kilometrage between engine overhauls is increased. It is therefore of vital importance that the auxiliaries, such as oil pumps, water pumps, governors, camshafts, &c., be sufficiently robust to ensure that the main working parts control the periods between overhaul. The majority of engine failures experienced in service are due to the auxiliaries, and consequential damage when these fail is often very heavy. There are many engines in service to-day which have well-proportioned main parts, but exceptionally poorly proportioned auxiliary or secondary parts. If the designers of these engines had thought in terms of kilometrage or mileage as the user must, the quota of failures recorded against rail traction oil engines would probably be very different. It must be pointed out, however, that by far the major proportion of railcar failures are due to other causes, such as transmission, controls, axles, brakes, bogies, and auxiliaries, &c. Unfortunately, under the railway system of working, all failures are booked under one heading, "Diesel Services," which is liable at times to give the impression that the engines are responsible for a considerable proportion of failures due to other causes.



NOTE.—(1) All bearings seized with load of 800 kilos.
(2) R.p.m. of test journal, 1300.
(3) Lubrication equal for all bearings.

FIG. 34—*Trials of Lead-Bronze Bearings*

Elaborate propaganda has been issued by some manufacturers, notably Continental, with

regard to engine transmission efficiency. This factor has very little effect on the final operating costs, and it would have been of far greater advantage to all concerned if more attention had been paid to details of design that would facilitate overhauls and increase the reliability of the engines and transmissions generally. The fuel costs are approximately 8 per cent. of the total operating costs of the railcars powered by the engines dealt with in these notes. Generally, the transmission, auxiliaries, and running gear are the worst offenders with respect to maintenance, but there is no reason why engines should be employed which require the crankshaft re-bedding, head joints, &c., re-facing, and new auxiliary bearings throughout after only 70,000 kiloms. The cleaning of the oil filters, fuel filters, and the changing of the lubricating oil and injectors, and the general cleaning and the correction of small defects, &c., should be the only work necessary in the running sheds. This is only possible with engines having well-designed component parts.

With regard to the engines described in these notes, the piston rings, valves, &c., will give satisfactory service without attention for 100,000 kiloms., and the author is of opinion that this should represent the period between partial overhauls for any new engines working 200,000 kiloms. or more between general overhauls. Floating bushes are to be recommended for all auxiliary spindles, &c., in preference to ball or roller bearings.

Transmission.—Electric transmission properly designed offers many advantages for all traction units powered by engines of over 200 B.H.P., particularly in countries, such as the Argentine, where high-speed operation is required over unballasted track. From the user's point of view, a slight difference in efficiency from engine coupling to wheels is of no great importance, provided the performance is satisfactory and the total operating costs low. Experience has shown that the low maintenance costs and reliable working characteristics of well-designed oil-electric units outweigh the fuel economies claimed for units having more efficient transmissions.

The principal advantages of electric transmission in so far as the railway user is concerned, can be grouped as follows :—

(1) The transmission does not influence the location of the engine.
(2) All components can be arranged to ensure even weight distribution.
(3) Components can be easily grouped to facilitate maintenance (kilometrage basis).
(4) Engine speeds can be selected to suit the engine characteristics.
(5) Automatic foolproof control and protective devices for single and multiple working can be arranged simply.
(6) Full engine power available whenever required.
(7) No risk of damage to engines due to transmission defects.
(8) No necessity for " free-wheels " to protect defective or failed engines.
(9) Simple and cheap maintenance with minimum special plant facilities.
(10) Maximum reliability.
(11) Simplicity and reduced number of working parts.
(12) Less service spare parts required.

The only disadvantage offered by electric transmission is the comparatively high prices charged by the manufacturers for the component parts. There is no doubt that this influences the choice of equipment to a considerable extent, in spite of the fact that low-operating costs and the lower initial cost of the stock of spare parts required, produce a better return on the capital. This latter point is of greater interest to overseas railways who are not close to the manufacturers. In this respect, it is of interest to note that with regard to the railcars considered in these notes, the cost of the stock of spare parts recommended by the manufacturers approaches that of a complete articulated unit. The term " electric transmission," however, must not be taken loosely as very specialised experience, and a thorough knowledge of all operating conditions is necessary to ensure satisfactory results. The application of " straight " electric equipment, as used on electrified systems over stone-ballasted track, only leads to trouble unless the necessary precautions to meet the different conditions are taken. Perfect harmony in the design and construction of the complete units is essential. It is due to failure in this respect that many oil-engined railcars have given so much trouble in service.

An argument sometimes advanced against electric transmission is that repair staff will be more difficult to train. In practice, this is not the case. The average electrician accustomed to train-lighting equipment, plant maintenance, &c., is easily taught to handle electric traction equipment, whereas the training of the staff to handle the complicated mechanism and control equipment associated with mechanical transmission offers a much greater problem.

General Lay-out and Design of Railcars (over 200 B.H.P.).—Fig. 35 shows a recommendable lay-out of railcar power equipment and auxiliaries for single and multiple working, with engines over 200 B.H.P. for use in countries, such as the Argentine, where dust and track conditions are severe. It will be noticed that all air intakes are located on the side of the roof. Tests showed that dust, grass, thistledown, &c., thrown up from the track reached window level. The air supplied to the main and auxiliary generators is utilised to create a slight pressure in the closed engine-room, which effectively prevents dust creeping under the doors and partitions, thereby ensuring the best working conditions for the engine and control gear operating in that compartment. The fireproof walls of the engine-room ensure freedom from a fire spreading, should one occur.

The engine and the main and auxiliary generators are mounted on a wheeled frame to enable easy withdrawal to be made through the removable partitions on to a mobile platform, whenever this is necessary. Trials with this arrangement have shown that engines can be changed in from two to three hours once the staff have been properly trained, and, further, it is not necessary to place the railcars over

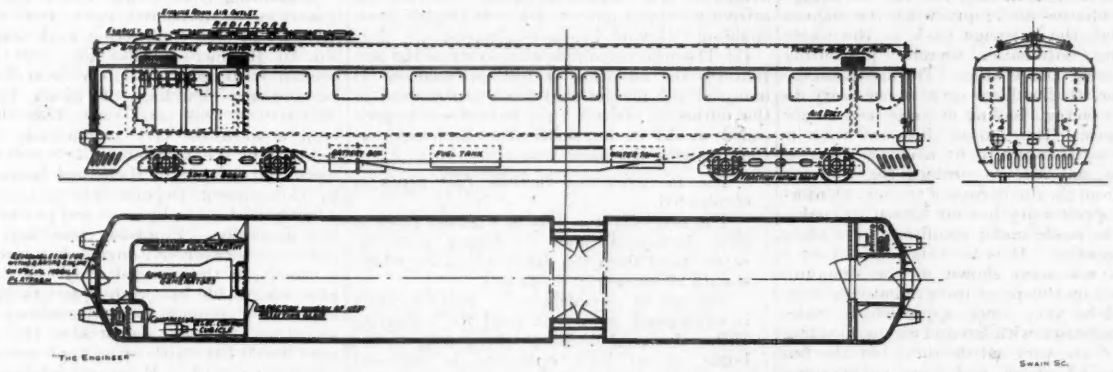


FIG. 35—*Lay-out of Railcar Power Equipment and Auxiliaries for Single and Multiple Working with Engines of over 200 B.H.P.*

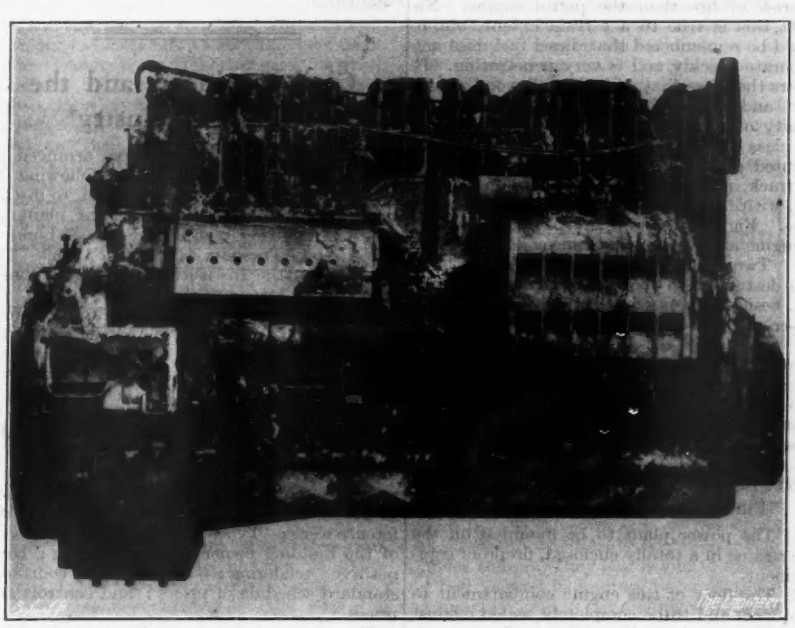


FIG. 36—*Fuel Pump Side of Engine Destroyed by Fire*

jacks or under a crane, as is necessary with bogie-mounted engines.

It will be noticed that the traction motor bogie is located remote from the engine. This improves weight distribution and also keeps the motors free from any leakage oil, which is detrimental to the insulation and commutators. The traction motor air intake is *vid* the hollow partition between the driving compartment and coach. This has been tried and gives excellent results.

Roof-mounted radiators have proved more satisfactory than undercar-mounted, because of the freedom from choking with dust, &c. The roof arrangement also has the advantage that the radiators are empty when the engines are stopped, the drainage back to the water tank being automatic, thereby preventing freezing during cold weather. The disadvantage is, however, that a large area is necessary to ensure satisfactory cooling at extreme summer temperatures. The author believes that it would be satisfactory to fit a cover with air entry fore and aft, to protect the radiator elements from the direct rays of the sun. Unfortunately, opportunity has not arisen to enable a test to be made under conditions prevailing in the Argentine. It is for this reason that a cover has not been shown in the diagram. Information on this point from radiator specialists would be very much appreciated. Side-mounted radiators with fan and air duct leading to the roof are very satisfactory, but the fan motor absorbs power, and more engine-room space is required for location. Thermostatic temperature control is essential with either system, to ensure quick warming up and to guard against operating under cold conditions.

The engine-room floor is of steel with drainage leading leaking oil, water, or fuel on to the track. The components are grouped to facilitate maintenance and ensure maximum availability. The articulation of railcars is not be to recommended. Single units capable of multiple working offer far more service flexibility and ensure greater availability, as only defective cars need be out of service for repair.

Fire Hazard.—It is claimed that owing to the nature of the fuel used, the oil engine offers less risk of fire than the petrol engine. No doubt this is true to a certain extent, but it should be remembered that diesel fuel does not evaporate quickly and is very penetrating. It follows therefore that with time all wood, grass, dust, and other absorbent materials in the vicinity of the engine becomes converted into first-class kindling material. With bogie-mounted engines, especially when exposed to the track, it is impossible to maintain cleanliness, with the result that fire risks exist at all times. Fig. 36 shows the fuel pump side of an engine as taken from a railcar destroyed by fire. Two complete articulated units have been destroyed on the Central Argentine Railway, besides others on other railways. Due to the seriousness of the situation, a sub-committee was appointed to investigate the matter thoroughly, and, in addition to dealing with existing equipment, definite recommendations were put forward with regard to future equipment. This section of the sub-committee's report is transcribed below :—

RECOMMENDATIONS FOR NEW RAILCARS
(FIRE HAZARD SUB-COMMITTEE)

(1) The power plant to be mounted on the underframe in a totally enclosed, fireproof compartment.

(2) The floor of this engine compartment to be of steel and to be completely sealed against entry of air. A drain to be provided at its lowest point to collect fuel and oil leakage.

(3) The main fuel tank is to be carried on the underframe and special care taken that the fuel pipe and joints are accessible. Whatever system is used for lifting the fuel from the main to the service tank, this should be cut out by the main controls. This prevents large volumes of fuel being spilled or pumped over the engine when the car is standing, in the event of a broken pipe.

(4) The engine-room should be provided with an efficient air intake from a source of clean air. If possible, the air intake should be arranged to create a slight pressure inside the engine-room, thus effectively preventing the entry of dust, &c.

(5) A fireproof partition should be provided between the engine-room and the rest of the car. This should be fitted with a heat-resisting glass inspection window.

(6) All timber and inflammable materials are to be eliminated from the bodywork. The floor should be of some fireproof material, such as "Decolite," with corrugated steel below. If three-ply wood is used for panelling, it should be treated by some fire-resisting process, such as "Oxylene" or similar. It is thought, however, that after the war many new plastics will be available and non-inflammable sheeting of attractive appearance will be obtainable, thus enabling "Rexine" to be eliminated.

(7) The sub-committee wish to stress the fact that by the adoption of recommendation (1) many of the factors that have contributed to the outbreak of fires that have been experienced would be automatically eliminated, as the following list indicates :—

The necessity for flexible fuel pipes is eliminated.

The necessity for flexible exhaust pipes is also eliminated, and no danger need be experienced from the exhaust system, which should be efficiently drained.

The use of flexible electric control cables is eliminated, as is the need for mounting E.P. valves, oil pressure relays, &c., on the bogie, where their operation is rendered unreliable, due to vibration, moisture, and dust. Incorrect operation of the control equipment can produce fires in some equipments.

The cleaning of the power plant becomes simple, due to improved accessibility and prevention of entry of dust, grass, &c.

Finally, it is pointed out that several million car kilometres have been run in this country by units embodying these features, and there has never been the slightest sign of fire on this type of car.

It is believed that the origin of the fires on the Central Argentine railcars was due to sparks from the brake blocks under high-speed braking conditions.

Civil Engineers and the Building Industry*

THE fourth of the Conferences arranged by the Institution of Civil Engineers, following the Inaugural Conference held in August, to discuss the building industry and post-war planning, took place at 25, Great George Street, London, S.W.1, on Tuesday, December 8th. The President of the Institution (Sir John Thornycroft, K.C.B.) was in the chair.

This Conference may be regarded as almost the most constructive of the whole series, for not only were many interesting views expressed with regard to modifying and improving existing contracting conditions, but there was also a very clear-cut view on the part of all the speakers that the building industry, as usually envisaged, and the civil engineering industry must be kept quite separate in anything that might be done as regards types of contract. The items which formed the subject of the Conference were :—Types of contract ; the interests of the building owner ; State building ; competitive tendering ; a standard contract ; standard schedule of prices ; and controls and prices.

The opening speaker was Mr. E. J. Rimmer, a barrister-at-law, who has specialised in contract law, in which he is recognised as a leading authority, and who is also an associate member of the Institution. He started off with an examination of the various forms of contract now in use. For instance, there is the lump-sum contract, under which the contractor is paid a certain sum for certain work, with additions for variations which must be clearly defined. Then there is the bills of quantities contract, largely used in civil engineering and also known as the measured value or schedule of prices contract. The lump-sum contract is rarely used for work prepared by architects or civil engineers. Mr. Rimmer said he preferred to apply the term "schedule contract" to the kind of contract under which the contractor engaged himself to carry out such work as might be ordered, there being only a broad outline of the time the work would take, the contractor being paid at the rates set out in a schedule of prices. These might be tender prices or prices in a printed list, such as the Standard Schedule of Prices issued by the Ministry of Works and Planning.

Remarking that it was under the bills of quantities or measured value that the vast majority of civil engineering work was carried out, Mr. Rimmer said that since 1909 there had been in existence the R.I.B.A. form of contract for ordinary building—of which the latest edition was 1939—and since 1930 there had been a form for civil engineering contracts arranged by the Association of Consulting Engineers, but neither of them had been adopted by Government Departments and, except in a few special cases, by local and public authorities generally. Emphasis was laid on the difference between civil engineering and building contracts, at the moment when the suggestion was being made in certain quarters that there might be a common form of contract for both industries. It was shown how the R.I.B.A. form would have little or no application to civil engineering work. Moreover, whereas in the ordinary building contract sub-contractors might carry out 40, 50, or even 60 per cent. of the whole value of the contract, for which lump-sum provision was made in the contract quite provisionally owing to the absence of information on the part of the contractor, in the case of civil engineering contracts the contractor was expected to carry out the whole of the work, and could only sub-contract for special work with the consent of the engineer. The use of provisional sums for the employment of contractors was very rarely resorted to, and then only for special work, such as machinery.

Mr. Rimmer went on to show various other differences between building and civil engineering contracts, and he specially mentioned that a building contractor, if he carries out the work according to the contract, is under no responsibility for any damage, whereas under civil engineering contracts the contractor is nearly always required to accept liability for defect or damage from whatever cause. Under the Association of Consulting Engineers' form of contract some relief had been obtained from this obligation on the successful completion of the work.

The evils of open competition were drawn attention to and also the undesirability of adopting the policy of accepting the lowest tender by local authorities.

Finally, reference was made to the "cost—plus" form of contract, which has been largely used during the present emergency, and Mr. Rimmer remarked that, although it had been criticised as resulting in wastage of expenditure, carelessness, laziness, fraud, and other things, it would be unwise to condemn the whole system. It had been used as an expedient during the war, and if it were to be used at all it must have its own technique and its own safeguards, which could not be provided without careful consideration. There had been large contracts carried out on this basis during the intervening war period, and in any review of methods of contracting it was a system which at least should be examined.

Mr. W. T. Halcrow (Member of Council, Institution of Civil Engineers), speaking as a civil engineer and a civil engineering contractor, at once expressed his disagreement with any suggestion for a form of contract applicable to the building and also the civil engineering industries, adding that he was not aware of a material demand for a combined document nor of any disadvantage in having two separate documents. The lump-sum contract had not been found to be satisfactory in civil engineering contracting, and he preferred the bill of quantities and schedule of prices form of contract. But there were two matters arising out of it which required attention. In the first place,

* Articles dealing with others in this series of Conferences appeared in our issues of September 4th and 18th, October 16th, and November 13th last.

the invitations to tender should be limited to those who could show they had experience in carrying out the class of work covered by the contract. That prevented extremely low tenders being submitted, unsatisfactory work, and arbitration. There might be difficulties in the case of local authorities where certain members might want particular firms placed on the list whom the engineer did not, but the engineer must insist in having his own list, and then it would be safe to select the lowest tender. He did not like prime cost or target contracts, and urged that the method of tender should be maintained, with the engineer doing everything possible to prevent a contract being placed at a figure which was clearly above or below a fair value for the work in question. It was essential to keep costs of production down, or we should not be able to compete successfully with other nations for trade and therefore accumulate credit for the purchase of food and raw materials from abroad. Therefore efficiency must be applied to the design and execution of public works; the present policy in some quarters seemed to be to encourage inefficiency.

Speaking of standard conditions of contract, he said that the Association of Consulting Engineers' form, issued in collaboration with the Federation of Civil Engineering Contractors, had proved of great service, and but for the war a revised edition would have been issued, sponsored by the Institution of Civil Engineers in collaboration with the other two organisations. Such conditions should not be in complicated legal phraseology, for engineers and contractors did not want to seek legal advice at every turn as to the meaning of a phrase. The standard schedule of prices was in much the same position. It had been in use for many years and the one issued by the Ministry of Works and Planning had been favourably received, but it was inapplicable to civil engineering works.

Asking for what might be termed a commonsense view of those matters, Mr. Halcrow said the engineer should have the power to use his sense of fair play in regard to contracts rather than be bound by strictly legal interpretations of contracts. For a century the civil engineer had been in supreme control of his contracts, and it was in the interests of all parties that at should continue. When the contractor knew that the engineer had a reputation for giving a square deal, he would keep his prices down. If, on the other hand, he knew the interpretation of the contract was to be left to individuals or bodies possessing no practical knowledge of public works, he would quote higher prices. Responsible contractors had told him that was frequently done. He hoped that it would become uniform practice in connection with Government and all other public contracts that the engineer was given the authority to take the final decision.

Mr. Sydney Tatchell (R.I.B.A.) started off with a few definitions of the parties concerned with contracts, which assumed that everybody was honest and straightforward, and, in fact, that human nature is not such as is sometimes found, but approximates more to the ideal. He followed with a brief history of the introduction of the R.I.B.A. form of building contract, and said this was intended only as a guide to the builder in carrying out the work. Adding that the present form was more valuable than its predecessors, he stressed the impossibility of producing a document which would cover every imaginable contingency. The policy of selecting firms to tender and taking the one in which the price was more or less the average of them all was said to have been adopted with success.

Mr. H. J. B. Manzoni (City Engineer, Birmingham) also stressed the difference between building contracts and civil engineering contracts, and pointed out that the system of competitive tendering was popular in public life because it provided fewer opportunities for criticism on the part of the public. If selected firms only were asked to tender, there was much room for public complaint. Accepting open competitive tendering as the best system for public authorities, he said the engineer must be prepared to stand up against possible opposition if he did not think it wise to accept the lowest tender. On many occasions he himself had overlooked the five lowest tenders received. After pointing out possibilities of standardising a good number of documents involved in a contract of the cost-plus system, he said the breakdown of it during the present war was one of the greatest condemnations of the general moral level of this country. He also discussed the problem of loss of employment on contracts through bad weather, and said it would be necessary to make up our minds whether the chief reason of a contract was to employ labour or get a job done. It might be necessary in post-war work to relate the labour used to the amount of money involved, otherwise there might be public authorities, with the best intentions in the world, letting contracts which would employ 100 men or anything up to 5000 men instead of 5000 machines and one man! On the general impression that Government Departments required local authorities to accept the lowest tender, Mr. Manzoni said his experience had been that the Departments took a very liberal view and would accept the view of a local man that a particular contract should not be accepted.

Mr. Oswald Healing said the cost-plus system had attracted much adverse criticism, as being uneconomical in the use of material and labour and as tending to prolongation of the time the operations were in progress. The principal objection was the absence of the stimulus to economy afforded by the competitive tender. The target contract, introduced to mitigate some of the evils of the cost-plus system, had only been partially successful, and, he believed, had now been abandoned by Government Departments. The system of inviting tenders in competition for building work on the basis of bills of quantities was old established and, if properly administered, could be said to afford the best means of securing reasonable tenderers and arriving at proper values for buildings. In recent years, the advantages of competitive tendering had been largely discounted, if not destroyed altogether in many cases, by inviting too many tenders, resulting in much diffusion of energy and therefore of expense. He spoke of the need often felt by architects for collaboration with the engineer in connection with special structures, such as deep foundations, retaining walls, and the like, and suggested this collaboration might be extended to structural steel work, reinforced concrete, and all other work for which the help of the constructor-engineer had been sought. Heating and lighting installations, it was suggested, might be designed by a consultant, and then invitations issued to specialist firms to submit tenders. It was admitted this would involve some revision of established procedure, inasmuch as the architect would have to accept as partners or advisers the consultants for special structures and engineering services.

It was pointed out that the Schedule of Prices recently issued by the Ministry of Works and Planning was directed solely to the class of building work comprised in the present Government programme of work, and the conditions were such that it was claimed there was considerable saving in time for making estimates, ensured contracts being placed with a sufficient margin of profit to secure good work, and that it was sufficiently flexible in its application to make it work in places with different local conditions. Further, it was hoped the document provided an opportunity for obviating the worst elements of the cost-plus contract. A standard schedule of prices drawn up on a wider basis and directed especially to housing or other standard types of construction might prove useful in placing contracts in the post-war period.

Sir George Burt, adding to what had been said as to the undesirability of having one contract form for building and for civil engineering, recalled being told, as a boy, to write an essay on the difference between "horrible" and "terrible." He said he was not very successful, but as regards the particular matter under discussion now, he knew of "terrible" work being done when the architect tried to do the engineer's job, and there had been some "horrible" examples when the engineer strayed into the architect's field! On the civil engineering side, he stressed the extent to which the contractor had to take risks, and quoted an example of a recent Government contract which said the contractor must take the risk of "obstructions under the ground, natural or otherwise." He, too, deprecated excessive competition and advocated long-term planning, so that private enterprise could see not weeks or months ahead, but longer, and so be in a position to give continuity of employment to operatives. Another evil of unregulated competition was the formation of combines, which was not to the public advantage, and he recalled that it was excessive competition which had resulted in combines of manufacturers being formed controlling 80 per cent. of the materials used in manufacture. What was wanted was some form of yardstick of prices on the lines of the Ministry of Works and Planning Schedule of Prices, which latter had been built up scientifically by picking out labour, plant, materials, overheads, and profit for each individual item. Whilst such a Schedule would not be useful for heavy engineering works, it would be invaluable for such things as road works, gas, water, and public services, as well as for buildings.

Finally, he said there would have to be some degree of controls and priorities after the end of the war, otherwise it would be impossible to rebuild socially as well as physically; the two together meant long-term planning and control to suit the available labour and material, and if these Conferences resulted in the building and civil engineering industries working in co-operation, whilst each kept to its own separate part, they would have achieved a great deal.

Mr. Harry Jackson said that, so far he had looked in vain for the leads to industry which, he understood, was the main purpose of these Conferences. So far as the present Conference was concerned, only Mr. Manzoni and Sir George Burt had applied themselves to the future possible conditions and how they would react upon industry generally. It was clear from what had been said that for practical working civil engineering must be separated from building. Experience was showing that a great deal more could be accomplished by agreement and organisation than by regulation. Expressing a preference for the schedule of prices contract, Mr. Jackson discussed in some detail the relationships between the interested parties in the future if the national interest was to be served in the most effective manner.

Others took part in the discussion, and it was announced that the fifth and final Conference will be held on Tuesday, January 5th, 1943.

South African Engineering Notes

(By our South African Correspondent)

CAPE TOWN, October 9th.

Useful Mineral Discoveries

COLONEL C. F. STALLARD, Minister of Mines, addressing a meeting of his constituents at Maritzburg on September 15th, said the Government was building up secondary industries. As Minister of Mines, Parliament had conferred upon him power to take action in regard to the development of the country's mineral wealth which had never been given to a Minister before. They had begun to search for, and had success in finding, some of the more rare minerals used in the making of steel alloys. They had found vanadium and—more important still—tungsten. South Africa was producing a very much larger amount of tungsten than ever before, and he hoped that they would be able to improve on that production very shortly. Prospecting parties would go out in various parts of the Union. When they found any promising deposit, they would have the duty of exploiting it to see whether it had commercial prospects. If the owner of any mineral rights failed to develop them himself, he (the Minister) could call for tenders and give a mining lease to someone who could work the rights. The Union this year would produce mercury for its needs. He concluded by

saying that the gold-mining industry had to be preserved.

A State-owned Merchant Fleet

The fact that the South African Shipping Commission is sitting at various Union centres is exciting considerable interest in shipping circles, and among importers and exporters, and much evidence is being placed before the Commission. This evidence differs very considerably, for while representatives of the various large British ship lines, who in the past and up to the present have carried practically all the coastwise cargo offering, are of opinion that they provide all the shipping accommodation required, other interests do not see eye to eye with them, and are of opinion that there should be South African coasting services provided. The Commission appointed by Government is investigating the future prospects of the Union Government's shipping services—consisting, so far, of three vessels of medium tonnage, which are employed carrying coal to the East and bringing back cargoes of timber, &c.—and the possibilities of further post-war developments; also the prospects offered of the establishment of purely coastal services being run successfully.

There appears to be a strong feeling in favour of establishing local coasting services and also of encouraging shipbuilding in the Union. Government appears favourable towards both these enterprises.

Shipbuilding has always been carried on at two or three ports in the Union, although so far only small vessels have been built, but those engaged in the industry are confident they could cope with much larger craft. As to repairs, these have been carried out on the largest scale, some of the ships being of over 15,000 tons capacity, and the repairs including extensive rebuilding of hulls, and repairs to steam and oil engines and turbines. One job just completed has been the rebuilding at Mossel Bay of the tug "Eland." This was completed in August. The "Eland," built in 1896, was destined to be scrapped this year, but in view of the great demand for shipping, it was decided to rebuild her. The new craft is a credit to the fine work of the artisans. Simultaneously with the launching of the tug, one of the big S.A.R. locomotives which had been overhauled and refitted at the local railway workshops was sent on its first trial run. Some time ago a Cape Town marine engineering firm constructed an entire rudder for a large liner. Now that the Union possesses at Pretoria a steel works which can produce steel of any kind required, and roll or forge to any specification demanded, the prospects of starting shipbuilding on a full scale are considered to be very bright.

Professor Hutt, of the Unitversiy of Cape Town, has given evidence before the Shipping Commission about the economic aspects of shipping, and suggested that South Africa had not reached the stage at which any form of State-owned productive enterprise could be undertaken in the general interest. In his opinion that is no case for setting up a further State enterprise. The reservation of coastal traffic for South African vessels would be a particularly undesirable form of preference, as it would constrict trade. The burden would be especially severe in the case of the Union, which was relatively more dependent upon external trade than most countries which had decided to keep coastal trade for themselves. As regards ship repairing, the Union should endeavour to reduce costs drastically, so that it would be possible to compete in the international market. A State-owned fishing fleet, if wisely used, would possibly enable the price of fish to be greatly reduced, with considerable benefit to the population, especially in helping to eliminate the widespread malnutrition existing. Summing up, Professor Hutt said that, taking all circumstances into consideration, he felt that until it was possible to bring about a radical change in the political traditions of this country any further State undertaking would be certain to be burdensome.

Must Develop Secondary Industries

An appeal to industrialists to start new industries in the Union and to help overcome the "shortages" problem was made by the Minister of Mines recently. "My attention," he said, "has been called to the growing shortage of stocks throughout the country and the great difficulty in getting them replenished. In many lines it is most probable that there will be no replenishment. It is not in any way due to Government action or inaction. If we were out of the war, we would have little or no shipping coming to our ports at all." There was plenty of capital available for fresh enterprises, and there were many sources of semi-manufactured products which could be carried several stages further, with great advantage to the country and to the people. He recently visited a large new glass factory which struck him as being a most efficient and go-ahead concern, and he was told that they were turning out a million bottles a week. "The quantity of the goods which we can supply from our own sources in South Africa must be vastly improved," said the Minister. "I sincerely believe that concentrated efforts to produce more and a greater variety of consumable goods in South Africa itself—helped by imports from sources outside our borders—would be of permanent benefit to our country."

Women in S.A.R. Workshops

The Union Railway Administration has released over 10,000 men from all over the Union of South Africa for active service, and it is to release some more now that women are being employed, not only in the Pretoria railway workshops, but also the workshops at Salt River, Durban, East London, Bloemfontein, and Uitenhage. There are already over 300 women employed in these workshops. Two weeks ago over sixty more men were released for active service from the Pretoria railway workshops. Their places have been taken by women, who are already earning golden opinions, even from those who did not at first welcome the advent of women into a sphere which had formerly been confined to men. Nevertheless, the women have received, and are receiving, every help and encouragement from the men.

The majority of the women are working in the trimming shops. Others are making munition boxes in the carpenters' shop, and a third group is engaged on fuse details in the machine shop; 98 per cent. are engaged on work concerned with war production, which is so big a branch of railwaymen's work to-day. In the machine and carpenters' shops all the women are on war production. When these women are engaged preference is given first to widows and single women, then the women whose husband's pay is not made up by employers are considered. The third group to be specially considered are those women whose husbands are on active service, especially those in prisoner-of-war camps.

The women are treated exactly like the men. They are put on piecework in the machine shop and work in three shifts of eight hours, working forty-eight hours a week. They are said to display 100 per cent. efficiency and keenness. Their ages range from seventeen to over fifty years. It has been found that the younger women work better as machine operators, but that the older women score when stability is required.

The railwaymen who cannot be spared for active service are playing a very big part in the country's war production. There are men who have been working on war production for twelve hours a day on six days a week for the past two years.

Mr. F. C. Sturrock, Minister of Railways and Harbours, who has just returned from a visit to England, states that as a result of his visit it has been possible to arrange for a considerable improvement in the supply position so far as South Africa is concerned. He also announced that a new graving dock of approximately 680ft. in length is to be built at East London, as well as a floating dry dock of 16,000 tons capacity at Durban. This dock will be fabricated in this country, and will be a purely war-time measure. The East London dry dock will be able to take the largest type of British cruiser, apart from merchant vessels of up to 6000 or 8000 tons. As a result of arrangements made, Mr. Sturrock hopes that it will be possible to maintain shipping services to this country sufficiently to meet our reasonable needs, but at the very best the Union will not have more than one-third of its normal peace-time shipping available to meet the requirements of South Africa. The bottle-neck in the supply position is, of course, shipping.

Sixty Years Ago

THE TRANSIT OF VENUS

To many modern readers it may seem strange that we should have devoted the opening page of our issue of December 15th, 1882, to an article entitled "The Results of Transit of Venus Expeditions." Nevertheless, the scientific, physical, practical, and, we might well add, the romantic interests of the subject amply justified this departure on our part from the strictly engineering field. At a transit of Venus the planet moves across the sun's disc, and if the instants at which contact is made and lost are observed at two or more points on the earth's surface at known distances apart, the distance of the earth from the sun can be calculated. Four transits of Venus occur every 243 years, the intervals between them being 8, 105½, 8, and 121½ years. Only five transits have so far been observed, namely, in 1639, 1761, 1769, 1874, and 1882. The next two will occur in 2004 and 2012. Two Englishmen alone observed the transit of 1639. For those of 1761 and 1769 the principal Governments of Europe fitted out expeditions to proceed to various parts of the world. For the 1769 transit Captain Cook carried the members of a British expedition to Tahiti and then proceeded on his voyage of discovery in the "Endeavour." The results obtained on both these occasions were disappointing, because of a phenomenon known as the "black drop." The precise instant at which the edge of the planet touched or left the edge of the sun was rendered indeterminate by an optical appearance resembling a spot which seemed to be drawn out of the planet and to cling for a time to the edge of the sun. The effect of this phenomenon was to leave an uncertainty of several million miles in the estimate of the earth's distance from the sun. The best value of that distance as calculated from the observations made in 1761 and 1769 was 95,250,000 miles. For the transit of 1874 international expeditions were organised on a very elaborate scale, special instruments were made and photography was enlisted as an aid to visual observation. The results were again disappointing. The "black drop" and other phenomena intervened to make the precise times of contact uncertain, and the earth's distance from the sun was estimated at 93,300,000 miles, with a possible error of 1½ million miles. For the transit of December 6th, 1882, still more elaborate arrangements were made. In our article we did little more than record the success or failure of the actual observations made by the numerous expeditions that had been despatched all over the world. It can now be said, however, that as a result of the 1882 observations the earth's distance from the sun was placed at 92,500,000 miles with a considerable measure of possible error. . . . Recent work on this subject has made use of the tiny planet Eros in place of Venus. This asteroid, only about 15 miles in diameter, comes within 15 million miles of the earth once every thirty years. Observations made of it in 1931 have led astronomers to place the earth's distance from the sun at 93,005,000 miles with a possible error of plus or minus 9000 miles.

PARIS EXTENDS ITS UNDERGROUND.—It is reported that the extension of the Paris Underground Railway system between the stations of Charente and Charent Ecole has been opened for traffic. Escalators at stations on the Metro have been stopped in order to economise in the use of electricity, but as most of the stations are just below the surface the platforms are approached by short staircases. Only a few stations at a deeper level are equipped with escalators.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer

Argentine Public Works Expenditure

Although the need for conserving the production of iron and steel materials for essential purposes connected with the war will prevent British firms from participating in sales to Argentina of most of the materials required for the carrying out of public works, the programme which the Argentine Government has entered upon is not without interest to firms in Great Britain having peacetime connections with that country. According to *The Foreign Commerce Weekly*, the official publication of the United States Department of Commerce, the Argentine Government has entered upon a programme of public works calling for an expenditure of about 4000 million pesos. These works include the estimated cost of the construction of two dams in the north of the Republic, amounting to 33,303,000 pesos. National works have been provided in order to cope with the urgent requirements of the country's activities, commerce, and economy, the chief amongst which is a plan for sanitary works in the most built-up areas of Buenos Aires and in the provincial capitals and cities. This scheme will involve an expenditure of about 800 million pesos. Hydraulic works for irrigation and the utilisation of hydro-electric power throughout the country will cost 650 million pesos and the work of developing the national territories 380 million pesos, bringing the total expenditure to 3763 million pesos. This sum is increased to approximately 4000 million pesos when one takes into consideration other proposed work, such as those relating to branches in the Province of Buenos Aires, amounting to 80 million pesos; hydraulic works in San Juan, 23 million pesos; the construction of a hospital at Rosario, 15 million pesos; and other works that have been planned apart from those provided by the provinces within their own jurisdiction.

The Pig Iron Market

The pig iron industry is operating at maximum capacity, and, with the exception of high-phosphoric grades, the production is quickly taken up. Even for high-phosphoric pig iron the demand has increased of late as a result of the sparing issue of licences for the acquisition of higher-grade irons. There are ample supplies of high-phosphoric iron available, and it is not likely that any tightness will develop. The position of the light castings foundries has recently improved, and, as a result, their demand for high-phosphoric qualities has broadened. Most of the requirements of these foundries are being supplied by Midland producers. There has been a continuous and big demand from the heavy engineering and allied foundries for some months for the higher-quality pig irons. These latter foundries have heavy order books and are not likely to complete the work they have in hand by the end of the year. In the hematite department the situation is practically unchanged. The Control only releases parcels of this pig iron for essential work, and then only when its use is absolutely necessary. This position has ruled for some time and will continue indefinitely unless the hopes that are entertained of receiving supplies of hematite ore from North Africa are fulfilled. The demand for low-phosphoric pig iron is maintained and comes chiefly from the engineering foundries. The position has been stringent for a considerable time, but the Control, by careful supervision of distribution, has maintained full supplies to the war industries. A recent increase in activity in all branches of the iron and steel trade has influenced sales of low-phosphoric and refined pig iron, and recently the stringency would appear to have become rather more pronounced, although there is no indication that it has affected the supplies for essential work. The production of ferro-manganese is on a good scale, but it barely meets requirements and producers appear to be fully sold for a long time.

The Midlands and South Wales

Extremely active conditions rule in the Midland iron and steel trades. For a long time an outstanding feature of the market has been the demand for special and alloy steels, which are used in large quantities by the munitions and armaments manufacturers. The requirements of these industries seem to be steadily increasing, and their demands tax the resources of the producing works. There has been a sharp increase in the call for cold-rolled strip and bright-drawn steel, which are urgently required for several descriptions of war work. The re-rolling industry in the Midlands is working under heavy pressure and the demand in all departments of this branch steadily expands. Consumers are offering business for completion this year, but it is now difficult to find firms able to consider this delivery. Most of the re-rolling works have booked a considerable amount of business for the first quarter of next year. The improvement in the demand for structural steel as a result of better conditions amongst constructional engineers has included an increased call for small bars and sections, particularly the latter. As a result, the works are fully occupied for a long time. The volume of business in bars is considerable and there has been a strengthening in the demand for reinforcing bars, whilst heavy tonnages of large bars are being taken up by the engineering industry. The raw materials position is satisfactory, although the home production of billets and sheet bars has had to be supplemented by withdrawals from stocks of imported materials. The Welsh makers of this, however, are supplying good quantities to works in other parts of the country. Use is made of shell discard steel where possible, and it is expected that imports of semis from abroad will be restricted for some time. Operations at the big steel works are maintained at a high rate. The demand for plates for the shipbuilders and tank makers is insistent, and some works are reported to have enough business of this sort in hand to keep them busy until the end of June, 1943. The South Wales steel industry is fully taxed to meet the requirements of consumers, and in some cases delivery dates show signs of lengthening. Substantial tonnages of steel are being produced and this demand is inclined to broaden as more work comes the way of the constructional engineers. Although the tinplate industry is not well employed, it absorbs the whole of the production of sheet and tinplate bars, which is limited by the amount of steel allotted by the Control. Active conditions rule in the sheet industry and most of the mills are well employed on Government orders.

The North-East Coast and Yorkshire

The iron and steel works on the North-East Coast are operating at maximum capacity, and although it is believed that production is higher than ever before, it is barely sufficient to meet the requirements of the firms employed upon war work. The call for plates is insistent, and big tonnages are passing to the shipyards and ship-repairing yards. A big programme of naval and mercantile construction is in hand and the demand for ship plates is expected to last for an indefinite period. Locomotive builders also have received good orders lately and their need for plates is expanding. So busy are the works that it is practically impossible to place orders for delivery until the early part of 1943. The re-rolling industry is equally busy and the mills are fully employed turning out small bars and sections. Supplies of raw materials, however, in the shape of billets and sheet bars are satisfactory, and so far as can be seen the present rate of activity is unlikely to diminish for a long time. The larger part of the billets and sheet bars reaching the re-rolling works now are of British manufacture, but imports are still arriving and there are good stocks of imported material in the country, which are occasionally drawn upon. The activity at the sheet mills seems to be on an increasing scale and lately there have been some good Government orders placed for black sheets. In Yorkshire the steel works are operating under extreme pressure from consumers, whose demands during the past few weeks have increased considerably. It is suggested that December will be the busiest month of the year in the steel trade. There is a strong request for special and alloy steel. The increase in production, however, has done no more than barely enable the works to meet the steadily increasing demand. The volume of business in basic steel has increased and all the works are fully employed. There is a heavy production of acid carbon steel, which passes immediately into consumption by the firms employed in the war effort. There is also an active demand for corrosion-resisting steel, which is not easily met by the producing works. The strip and bar mills are actively employed and the wire makers have good order books.

Scotland and the North

The month of December so far has been characterised by increasing pressure upon the Scottish iron and steel works. All available plant has been brought into commission. For a long time now the demand for plates has kept the mills fully employed and there is no sign of any decline in consumers' requirements. The shipbuilders, tank makers, and locomotive builders are eagerly pressing for delivery, but the largest consumers appear to be the shipyards, which have a heavy programme of work in hand. In addition to plates, there is an insistent call for shipbuilding steel of all descriptions, including sections, and this alone will keep many of the mills busy for some months. There is also a heavy demand for all descriptions of alloy steel, which is taken up in big quantities by armaments and munitions makers. The power plant makers in Scotland are operating at capacity, and it is understood that this branch of the industry has large requirements which will have to be filled in the not distant future. The tube makers in Scotland have good order books and large tonnages are passing into consumption. The sheet industry, also, has a large amount of work in hand, of which a good proportion is on Government account and includes large orders for special quality sheets. In the Lancashire area the steel works are fully employed, and reports are current of tightness developing in certain departments. The supply of forging blooms has become rather stringent and the supply of other descriptions of home-manufactured semis is also tighter than it was. In many cases consumers had built up some stocks of home-produced semis, but under the pressure of demand these have been eaten into and it is believed that larger supplies of imported material will have to be released. The demand for alloy steels is maintained and there is a vigorous inquiry in this department. The volume of business in steel bars seems to be increasing and there has been rather a run upon small bright-drawn bars. The demand for the larger-diameter bars has been strong for some time and shows no sign of decreasing. The collieries also are taking up good quantities of arch and roofing bars. The situation at the steel works and on the North-West Coast is unchanged. All the works are fully employed and have sufficient work in hand to keep them busy for a long time.

Iron and Steel Scrap

For the time being the iron and steel scrap position in Great Britain, so far as supplies are concerned, is satisfactory, but it is not one that can be regarded with complacency, and there should be no relaxation of the efforts to accumulate as much material as possible, even if it is necessary to keep good quantities in reserve. All the important users of scrap—steel works and blast-furnaces—are getting all the scrap they require. Certain descriptions are more difficult to obtain than others, and complaints are occasionally heard of the quality of the scrap which is available. The demand for heavy steel scrap is urgent, and rather stringent conditions rule in this department. Good heavy mild steel scrap, cut to furnace and foundry sizes, is somewhat scarce, and consumers are eagerly taking up the quantities offered. Similarly, there is an active request for bundled steel scrap, and hydraulically compressed steel shearings, and the quantities available are rapidly absorbed. The position with regard to mild steel turnings is entirely different. All grades of this description are arising in large quantities. The steel works have as much of this material in hand as they can conveniently use and are reluctant to add to their commitments. There is an irregular demand for mixed wrought iron and steel scrap for basic steel furnaces. Business in good heavy material is satisfactory, but consumers are showing little interest in the lighter descriptions, and, on the whole, business is quiet. It is generally agreed that the wagon label system has had a beneficial effect upon the scrap market and that it will result in the smoother working of transport. There is some congestion at some of the consumers' works, but this is regarded as being only a temporary inconvenience. A fair volume of business is passing in heavy cast iron in large pieces and furnace sizes at 76s. 3d. and 80s., and recently good quantities have been disposed of. The market for light cast iron scrap at 71s. 6d. and 74s. 9d. is rather dull and for the time being consumers are showing little interest in this material. The situation at the iron-foundries is unchanged and there is a good demand all over the country for cast iron scrap of all grades, but in most cases consumers report that they do not find it easy to obtain good quantities of the better-class scrap. There appear to be good supplies of wrought iron scrap, and the demand is not sufficient to take up the quantities offered.

BRAZIL SHORT OF PETROL.—One by one the countries involved in the war are feeling the shortage of petrol. Practically every private motor-car has disappeared from the streets of Rio de Janeiro, where local transport facilities are limited to tram-cars, motor buses, and taxicabs. The last named are restricted to short journeys, as their daily quota of petrol is limited. The tramway company and the bus systems of Rio de Janeiro have made emergency provisions for handling the increased volume of passengers.

Notes and Memoranda

Rail and Road

THE DAMASCUS-BAGHDAD HIGHWAY.—Preparations are being made at Damascus to inaugurate the recently completed Damascus-Baghdad trans-desert highway. This road is about 550 miles long. One half runs through Syria and the other half through Iraq territory.

OTTAWA TO REBUILD A BRIDGE.—The Canadian National Railways is planning to reconstruct the Laurier Avenue bridge in the city of Ottawa. The project calls for the replacing of corroded steel supports and piers with concrete. Application has been made to the Board of Transport Commissioners for permission to carry out the work.

CANADA BUILDS MOTOR WORKSHOPS.—Mobile workshops mounted on medium-sized motor lorries are being built in Canada for the field use of the Armed Forces. Each unit is equipped with a lathe, anvil, drills, welding apparatus, and a riveting hammer. Steel drawers are provided to hold spare parts, and there are also a tool cabinet and a work bench.

STANDARDISED U.S.S.R. LOCOMOTIVES.—Russia is getting its own "austerity" engines. Gradually freight locomotives, which are superseding the thousands of freight engines supplied by Germany and Sweden, are being built in the U.S.S.R., and are modelled largely on the American 2–10–2 locomotives, which were imported as far back as 1931, with modifications and improvements suggested by local conditions.

NEW MEXICAN RAILWAYS.—Considerable changes in the railways of Mexico are foreshadowed in an undertaking in which the U.S.A. Federal authorities will take a hand. A technical mission of American railway experts is in Mexico at the request of the Mexican Government, and the United States has agreed to finance the improvement of important lines of the National Railways of Mexico, and to pay for repairs to locomotives and other equipment.

THE LENGTH OF TRAINS IN U.S.A.—The number of coaches or trucks that make up the permitted length of a train in the United States is restricted by State laws, which vary, and have been mainly determined by considerations of long and severe gradients through mountainous country. The Interstate Commerce Commission, acting on behalf of the Federal Government, has now laid it down that these rules are to be disregarded by the railways concerned during the present emergency, to reduce the wasteful use of locomotive power and speed up transportation.

Air and Water

FORT WILLIAM AIRPORT.—Work has been started on a 900,000-dollar programme of improvement to the Fort William airport in Ontario. The principal work involves the lengthening and paving of the two main runways. To accomplish this it was necessary to extend the airport one-quarter mile to the west.

ANOTHER BRIDGE COMPETITION.—The American Institute of Steel Construction has announced another annual bridge design competition, open to *bona-fide* registered students of structural engineering and architecture in recognised technical schools and offers three cash prizes of 200 dollars, 100 dollars, and 50 dollars respectively for the designs placed first, second, and third. A jury of nationally known engineers and architects will judge the competition on February 17th, 1943. The executive offices of the Institute are at 101, Park Avenue, New York City.

FEEDING THE GANGES.—Indian irrigation experts have under consideration a project for the construction of a storage reservoir in Muzaffarnagar by building an earthen bund round an area which is for the most part a "jheel," known as Balta Jheel. The reservoir would be filled by means of a feeder from the Anupshahar branch of the Ganges Canal during the monsoon, when surplus is available. The water thus collected would be released through an escape to the Ganges River during the irrigation period, and, passing through the Lower Ganges Canal, re-enter the headworks which are lower down the river. The extra supply would increase the irrigated area on that system.

AN INDIAN CANAL PROBLEM.—For some years past a minor irrigation problem has been the growth of water weeds in the irrigation canals of the Bombay-Deccan area. The causes of weed growth and the methods of their prevention have been examined in a pamphlet recently published by the Central Board of Irrigation. In some of the canals the growth of weeds has been successfully prevented by the introduction of the "rush system." It involves the complete closing of a canal for a few days so as to allow the bed and weeds to be dried out by the sun. Where this is not possible, the construction of a suitable pick-up weir is recommended, so that fine silt is maintained in suspension, making the water turbid, which reduces the growth of weeds.

Miscellanea

INSTITUTE OF METALS.—Professor G. P. Thomson, D.Sc., F.R.S., has accepted the invitation of the Council of the Institute of Metals to deliver the 1943 May Lecture on the subject of "Electron Diffraction." His father, the late Sir J. J. Thomson, O.M., F.R.S., was also a May Lecturer, his discourse, in 1915, being on "The Conduction of Electricity through Metals."

AUSTRALIA MAKES MAGNESIUM.—Sufficient magnesium is now being produced in Australia to make the country independent of all imports in the magnesium and magnesium base alloy field. This is due to the foresight and initiative of the Broken Hill Proprietary Company, Ltd., of Australia, whose new plant is now well in its stride, supplying a first-grade product in quantities ample to cover the wartime demand for the metal.

COAL AND PLASTICS.—In the House of Commons, the Minister of Fuel and Power has been asked whether his attention has been drawn to a speech of the chief chemist of the Anglo-Iranian Oil Company suggesting that the coal industry should be made a source of raw materials for synthetic rubber and plastics; and whether any action is likely on the lines of that suggestion. The reply expressed the hope that coal would become, to an increasing extent, a raw material for the manufacture of such products. As to plastics, their manufacture was already largely based on the use of products derived from coal.

THE LATE MR. J. OWDEN O'BRIEN.—The death occurred, on Monday, November 30th, at his home, 10, Pilkington Road, Southport, of John Owden O'Brien, at the age of eighty-six. Mr. O'Brien and his son George were chartered patent agents, with offices in Manchester. He was a member of the Institution of Mechanical Engineers and rendered splendid service to the Engineers' Club, Manchester, of which he was a founder member, as honorary treasurer for some seventeen years. Mr. O'Brien had a very extensive knowledge of engineering and allied subjects, and was held in much esteem by all who had the pleasure of his acquaintance.

QUALITY CONTROL IN PRODUCTION.—An informal meeting of the Industrial Applications Group of the Royal Statistical Society will be held on Friday, December 18th, at 6.30 p.m., in the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, Victoria Embankment, W.C.2. The subject for discussion at this meeting will be "The Relation Between Design Tolerances and 'Control Limits' in Manufacture." The discussion is to be opened by Dr. B. P. Dudding, M.B.E., and contributions drawn from recent experience in the application of quality control to wartime manufacture will be made by Mr. W. J. Jennett, B.Sc., and by Mr. H. Rissik, A.M.I.E.E., M. Amer. I.E.E., F.R. Stat. S. Members of the Institutions of Mechanical Engineers, Electrical Engineers, and Production Engineers, and of the Institute of Engineering Inspection, and all engineers interested in the application of statistical methods to the control of product quality during manufacture, are invited to attend.

Personal and Business

MR. J. S. HUTCHISON has been appointed a director of Metal Industries, Ltd.

MR. H. G. MANN has been appointed a director of American Export Air Lines (Traffic), Ltd.

N. S. BELLMAN AND CO., Ltd., inform us that their new address is Terminal House, Grosvenor Gardens, London, S.W.1.

MR. S. R. RAFFETY, M. Inst. C.E., has been elected President of the Institution of Water Engineers for the session 1943–44.

BRITISH INSULATED CABLES, Ltd., informs us that Mr. H. J. Stone, formerly London branch manager, is now home sales manager at the head office of the company.

THE BRITISH ARC WELDING COMPANY (NORTH-EAST COAST), Ltd., South Shields, has engaged Mr. A. C. Ashton, M. Inst. W., as manager of its establishments at South Shields and Hull. Mr. Ashton has resigned his appointment with the Quasi Arc Company, Ltd., of Bilston.

MR. H. G. HANCOCK has been appointed Deputy Secretary to the Ministry of Supply. He was formerly Secretary-General to the British Raw Materials Mission in Washington.

MR. HARRY R. RICARDO, B.A., M.I. Mech. E., F.R.S., a Vice-President of the Institution of Mechanical Engineers, has been elected an honorary member of the American Society of Mechanical Engineers, New York.

AFTER December 31st Alfloc, Ltd., a subsidiary of Imperial Chemical Industries, Ltd., is to be incorporated with I.C.I. (Alkali), Ltd. This step has been taken to simplify administration and the business will be carried on as before by Alfloc's present staff at Ingersoll House, Kingsway, London, W.C.2. The same products will be sold as hitherto, and customers will receive the same technical service, which will be known as the Alfloc Water Treatment Service of I.C.I. (Alkali), Ltd.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Bradford Engineering Society

Monday, Dec. 14th.—Technical College, Bradford. "The Shorter Flame Hardening Process," E. Bramhill. 7.15 p.m.

Fuel Luncheon Club

Thursday, Dec. 17th.—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. "Coal Conservation," E. V. Evans. 12.40 for 1.10 p.m.

Institute of Economic Engineering

Sunday, Dec. 13th.—Waldorf Hotel, Aldwych, W.C.2. "Engineers' Brains Trust." 2.30 p.m.

Institute of Industrial Administration

Saturday, Dec. 12th.—Caxton Hall, Westminster, S.W.1. "Management To-day and To-morrow," Dr. J. A. Bowie. 2.45 p.m.

Institution of Automobile Engineers

Sunday, Dec. 13th.—LONDON GRADUATES: 12, Hobart Place, S.W.1. "The Possibilities of Motorcycle Engineering," Graham Walker. 2.30 p.m.
Tuesday, Dec. 15th.—LUTON GRADUATES: Technical College, Luton. "Cross Rotary Valve Engine Development," J. Jack. 6.45 p.m.

Institution of Electrical Engineers

Saturday, Dec. 12th.—N. MIDLAND CENTRE: Great Northern Hotel, Leeds. "Public Address Systems," S. Hill. 2.30 p.m.

Institution of Mechanical Engineers

To-day, Dec. 11th.—Storey's Gate, Westminster, S.W.1. "Poland's Industry," Professor S. Pluzanski. 5.30 p.m.
Friday, Dec. 18th.—Storey's Gate, Westminster, S.W.1. "The First Gas Turbine Locomotive," Dr. A. Meyer; "A New Rotary Compressor," A. J. R. Lysholm. 5.30 p.m.

Institution of Production Engineers

Saturday, Dec. 12th.—PRESTON SECTION: Royal Oak Hotel, Chorley. "Quality Control," T. Nuttall, J. Overend, and H. Kirkman. 2 p.m.
Thursday, Dec. 17th.—LEICESTER SECTION: College of Technology, Leicester. "Cutting Tools: Theory, Design, and Application," C. F. Gazard. 7 p.m.

Iron and Steel Institute

Monday, Dec. 14th.—Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. "The Linings of Large Basic Open-hearth Tilting Furnaces," A. Jackson. 6.30 p.m.

Junior Institution of Engineers

Saturday, Dec. 12th.—39, Victoria Street, S.W.1. Presidential Address. "Gas: Its Place in the National Fuel Economy," Sir David Milne-Watson. 2.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Dec. 11th.—Mining Institute, Newcastle-upon-Tyne. "The Electrical Equipment of Shipyards," H. M. Coatsworth.
Wednesday, Dec. 16th.—STUDENT SECTION: Bolbec Hall, Newcastle-upon-Tyne. "Marine Refrigeration and Insulation," F. Wright. 6.45 p.m.

North of England Institute of Mining and Mechanical Engineers

Saturday, Dec. 12th.—Neville Hall, Newcastle-upon-Tyne. General meeting. 2 p.m.

Royal Statistical Society

Friday, Dec. 18th.—INDUSTRIAL APPLICATIONS GROUP: E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, W.C.2. Discussion, "The Relation Between Design Tolerances and Control Limits in Manufacture." 6.30 p.m.

Sheffield Metallurgical Association

Saturday, Dec. 12th.—Royal Victoria Hotel, Sheffield. "The Utilisation of Alloy Steel Scrap," H. Bull. 2.30 p.m.